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ORONO

BULLETIN 389 NOVEMBER, 1937

Biological Studies of Maine Moths
By Light Trap Methods

Apantesis virgo L. (enlarged)

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AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE

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ACKNOWLEDGMENTS

Acknowledgment is made to Professor Glenn W. Herrick, of Cornell University, and to Dr. Edith M. Patch, of the Maine Agricultural Experiment Station under whose direction this work was done, for their encouragement and helpful suggestions; to Dr. W. T. M. Forbes for many determinations of species; to Mr. Henry Bird for determinations in the genus *Papaipema;* to Dr. D. W. Farquhar for valuable information upon the distribution of rare species; to Dr. F. H. Steinmetz for counsel and helpful criticisms; and to Mr. D. L. Moody for assistance in the laboratory. Credit is due the Department of Entomology of the Maine Agricultural Experiment Station for their generous co-operation and for placing at the disposal of the writer necessary equipment. To the Coe Research Fund Committee, University of Maine, appreciation is expressed for financial aid during 1934.

BULLETIN 389

BIOLOGICAL STUDIES OF MAINE MOTHS BY LIGHT TRAP METHODS[1]

CHARLES O. DIRKS

The insect fauna in the order Lepidoptera is not fully known in any section of North America. It is only in the older and more densely settled areas that the habits and distribution of this group of insects have been adequately dealt with. In abundance of species, the Lepidoptera include nearly one-fifth of all the various kinds of insects. Approximately, 1,400 species are known to occur in the State of Connecticut and 2,400 species in the State of New York. The number of species that inhabit Maine is unknown but a conservative estimate would place it between the corresponding numbers for the two states mentioned above.

Among all the different groups of insects, the larvae of the Lepidoptera are of primary importance as consumers of plant tissue. They are the herbivores of first rank among the Insecta. Certain Lepidoptera work within the plant on internal structures. More common are the species that devour the exposed leaves and stems. In fact, every plant structure is subject to attack by some member of the order. Many species of Lepidoptera are so notorious as plant pests that common names have been assigned them. For example, gardeners and farmers who grow field crops have applied descriptive names which suggest the destructive habits of a number of the species. Included among them are the cut worms, army worms, stalk borers, cabbage worms, tomato worms, and corn ear

[1] This paper is based essentially upon studies of moths collected in light traps during a period of four years at Orono, Maine. The data presented yield interesting information on the life history of many of the moths. A study was made of the factors involved in the attraction of moths to light traps. In addition, the paper includes a list of the food plants and includes the distribution of the most common species of moths captured during the study.

This paper is a revision of a paper submitted in June, 1935, to the faculty of the Graduate School of Cornell University as a thesis in partial fulfillment of the requirements for the degree of Doctor of Philosophy. The title of the thesis was "The Seasonal Occurrence of the Macrolepidoptera As Determined by Light Trap Studies at Orono, Maine."

worms. The fruit grower generally knows many of the destructive Lepidoptera under such names as bud worms, green fruit worms, leaf miners, loopers, canker worms, tent caterpillars, web worms, and codling moths.

In addition to those species that are common feeders upon certain garden, field, and orchard crops are the numerous members of the order that exist on shrubs or shade and forest trees. The leaves and buds of the trees are especially susceptible to attack, although a few lepidopterous larvae bore into the woody portions. In all the New England States certain species of the Lepidoptera that feed upon trees and shrubs are of major importance. In fact, a rather large proportion of the species of moths to be found in Maine may be listed as feeding upon some portion of a tree or shrub.

While it is true that the general statement can be made that no group of insects is more destructive to plants than the Lepidoptera, it is also a fact that only a relatively small number of the species found in Maine should be considered as highly injurious. Many of the moths listed in this bulletin are native insects which are present in small numbers year after year without seriously damaging any of their food plants.

HABITATS OF THE MAINE SPECIES OF LEPIDOPTERA

The north Atlantic seaboard states, including Maine, with their fairly abundant and comparatively uniform rainfall during the growing season, support a wealth of plant life and furnish nearly ideal conditions for the Lepidoptera. Sizeable areas in the State of Maine are yet in an almost primeval condition, and, as a result, few, if any, of the indigenous species have disappeared. The State is nearly equally divided into two life zones, the Transition and the Canadian. Each of these zones shows, and supports, many characteristic species of moths and butterflies.

The Transition zone in Maine forms a belt along the coast approximately 100 miles in width. Orono, where this study was conducted, is located in this area. The plant life of this zone in Maine differs but slightly from that of the lower elevations of the neighboring New England States. In general, deciduous trees are more common than the conifers. The oaks and other trees of southern origin are found with the beech, a species of a northern habitat.

In the Canadian zone, beginning about 100 miles from the coast and occupying the more northern and higher parts of the state, large forests of fir, spruce, and hemlock are to be found. There is, in addition, an abundance of poplar, birch, and other deciduous trees. A wide contrast occurs also between the herbaceous plants of the Transition and Canadian zones.

THE GROUPS OF LEPIDOPTERA STUDIED

This study is concerned only with the Macrolepidoptera. The Macrolepidoptera are composed of those families of the suborder Frenatae whose members are medium to large in size. In addition, the species of the Family Hepialidae in the suborder Jugatae are included among the Macrolepidoptera. Only the moths that are nocturnal or crepuscular in habits and are attracted to artificial lights are dealt with in this study. The butterflies and skippers are excluded since they are diurnal in habit. The very small night-flying moths are not considered.

METHODS USED IN CAPTURING MOTHS

Light-traps were used exclusively throughout the project for the purpose of securing specimens of moths. Each individual moth collected was examined to ascertain its sex. The females were dissected to determine the presence or absence of eggs and also to observe the degree of development of eggs that were present. The records for each species were maintained in such a manner as to establish as definitely and fully as practicable the number of generations per season and the time of adult activity. By continuing the study through four consecutive seasons, comparable data over a period of years have been obtained for numerous species. Temperatures and other weather data were studied to determine their influence upon the flight of moths at lights. Also, a number of incandescent and mercury-vapor lamps were tested.

The Traps Used.

During the first year of this study, a moth-trap consisting of an electric light hung in an inverted truncate cone of heavy tin patterned after that of Turner (1918, p. 125) was used. About half of the cone which would otherwise surround the lamp was cut

away. The lower end of the cone was fitted in the circular opening in the top of a rectangular box. The box measured 18 by 30 inches by 20 inches high and was constructed with a wooden top and bottom. Wire mesh covered the two sides and one end. A wooden door made up the other end of this structure. Crumpled masses of newspaper were used to fill up half or more of the space within the box. The moths, upon striking the sides of the cone, were projected into the trap and then many sought shelter in the mass of papers. Removal of material from the trap was slow. Many specimens were badly rubbed and were in poor condition for determination. Observations at night while the trap was in operation showed that the more active insects escaped.

In August of 1931, comparisons were made between the cone trap and a kerosene-pan trap. The latter method was judged to be superior and it was then used exclusively throughout the three following seasons.

The inverted top of a large ash or garbage can was utilized for the kerosene-pan trap. The top selected was 20½ inches in diameter and of varying depth from 2 to 3½ inches. The receptacle, when in place, was supported 3 feet above the ground and 6 inches below the light. It thus provided a shallow basin for holding water and kerosene. The kerosene on the surface of the water acted as a toxic agent.

In 1931, with the cone trap, slightly more than 3,000 specimens were obtained, while during corresponding periods of each of the three following years 10,000 or more moths were taken. Since the trap was operated at uniform intervals each year, the greater efficiency of the kerosene-pan over that of the cone trap seems evident.

Cleaning the Specimens.

Moths caught in the kerosene-pan retain the oil upon their bodies and require cleaning before determination of species. The following procedure was found to expedite the process:

1. The moths were first removed from the kerosene-pan and placed upon paper towels to drain for a few minutes.

2. The second step consisted of placing the moths in a coarse mesh (¼ inch) strainer and gently agitating the container up and down in high-test gasoline to remove kerosene and other foreign material.

3. The specimens were next transferred to a small mesh strainer for the purpose of bathing in one or two changes of gasoline for 15 or 20 minutes. With each transfer to a new bath, the moths were agitated to eliminate adhering loose scales.

4. After the series of gasoline baths, the moths were moved through three successive washes of benzene, by transferring the strainer holding the specimens from one container to the next. Each time the transfer was made, the previous washing fluid was allowed to drain off. The moths were retained in the benzene for a total period of 30 to 40 minutes.

5. At the end of the cleaning by benzene, the specimens were spread out on paper towels to dry. Such moths as appeared greasy (from the kerosene) at the end of a drying period of 30 or 40 minutes were again bathed in clean benzene for a period of 20 minutes.

6. If the cleaned moths were not immediately determined as to species, pinned, spread, etc., they were retained in relaxing jars to prevent drying out.

The gasoline and benzene washes were filtered either through cheese cloth or filter-paper and used repeatedly. Such filtering removes the scales and a certain amount of the grease. Large filter papers (7½ inches in diameter) were most satisfactory.

Several hundred moths were cleaned by this procedure in a short time. The cost of solutions was nominal. For small species of Macrolepidoptera and for the more delicate Geometridae, the kerosene-pan trap is not successful because of injury to the specimens secured, but for the more robust moths fair museum and cabinet material is obtained. Rubbing and battering of the specimens are reduced to a minimum by this process.

The Lights Used.

Only a few light sources were observed in detail, namely, a 200 watt clear tungsten lamp, a 500 watt frosted tungsten lamp, a 1000 watt frosted tungsten lamp, and a General Electric S-1 Sunlamp (mercury-vapor) lamp. By rotating the time for the different light sources, through each month of the season, weather factors and periods of abundance were equalized to some extent.

Location of Traps.

The choice of the location of the trap was limited by the availability of electric current. For the first three years, all material was secured by a trap on the edge of a field in meadow grass bordering the campus of the University of Maine. Heavy woods were within a few hundred yards of the site. In 1934, due to the land in the immediate foreground of the trap being closely pastured by livestock and also, because of the construction of buildings nearby, it became necessary to select another location.

The second site was about one-half mile distant from the first. The salient features of an open field of grass in the foreground and a timbered lot nearby were common to both locations. The two sites are believed to be sufficiently alike to render the data directly comparable for the entire four years.

Period Over Which the Light-traps Were Operated.

The short summer season in Maine and the cool nights restrict the activities of adult moths to a few months. The light was operated from early May to early October. Three or four of the most favorable nights during each week were selected for the gathering of specimens. This plan was consistently followed throughout the four years of the project. In the case of each species, the number of specimens captured during each week were added together, which seemed to be accurate enough for the purpose of this study.

LIST OF THE SPECIES AND SUMMARY OF THE CATCH OF MOTHS AT LIGHTS, ORONO, MAINE, 1931-1934, INCLUSIVE

The following list of species of moths is arranged according to Barnes and McDonnough's (1917) "Check-list of the Lepidoptera of Boreal America." Each species followed by a star indicates that a discussion of the species in more detail is presented in another section of this paper. The notes incorporated in the list give briefly the periods of flight for each species, the probable number of broods, the total captures made during the four years, the number of females, the number of gravid females, and the years in which captures were made.

List of the Species and Summary of the Catch of Moths at Lights, Orono, Maine, 1931-1934, Inclusive

FAMILY SPHINGIDAE

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
PROTOPARCE RUSTICA Fabr.	June 28	Aug. 7	July 1-24	1	10	1	1	32, 33, 34
CERATOMIA CATALPAE Bdv.	June 9	July 10	No marked peak		4	0	0	32, 33
SPHINX CHERSIS Hbn.*	June 18	Aug. 25	July 12-Aug. 9	1	43	9	9	31-34
S. CANADENSIS Bdv.	July 16				1	0	0	34
S. KALMIAE A. & S.	July 2	Aug. 22	July 17-31	1	13	4	4	32, 33, 34
S. GORDIUS Cram.*	June 5	Aug. 24	July 19-Aug. 17	1	46	4	4	32, 33, 34
S. DRUPIFERARUM A. & S.	June 19	July 26	No marked peak		8	1	1	31
LAPARA BOMBYCOIDES Wlk.	June 12	July 28	June 21-July 18	1	27	1	1	31-34
SMERINTHUS JAMAICENSIS GEMINATUS Say.*	May 26	Aug. 12	June 3-July 26	1	80	5	4	31-34
PAONIAS EXCAECATUS A. & S.*	June 4	Aug. 10	June 18-July 22	1	80	3	3	31-34
P. MYOPS A. & S.*	June 16	Aug. 15	No marked peak	1	36	0	0	31-34
PACHYSPHINX MODESTA Harris*	June 4	Aug. 3	June 14-July 25	1	52	18	14	31-34
DARAPSA PHOLUS Cram.	June 19				1	1		31
CELERIO GALLII INTERMEDIA Kby.	June 2	June 20	No marked peak	1	6	2	2	31-34

FAMILY SATURNIIDAE

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
SAMIA CECROPIA L.*	June 6	June 27	No marked peak	1	5	1	1	31, 32
S. COLUMBIA Sm.*	June 5			1	1	0	0	32
TROPAEA LUNA L.*	June 20	June 26			2	0	0	32
TELEA POLYPHEMUS Cram.	July 23	July 28		1	2	0	0	32
AUTOMERIS IO Fabr.*	June 1	July 17	No marked peak	1	29	2	2	31-34

FAMILY CITHERONIIDAE

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
ANISOTA RUBICUNDA Fabr.*	June 4	Aug. 13	June 14-July 5	1	42	1	0	31-34

FAMILY EUCHROMIIDAE

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
SCEPSIS FULVICOLLIS Hbn.*	June 3	Sept. 12	June 8-30; Aug. 12-28	2	225	1	1	31-34
CTENUCHA VIRGINICA Charp.*	June 12	July 29	June 15-July 20	1	402	2	1	31-34

FAMILY LITHOSIIDAE

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
HYPOPREPIA MINIATA Kby.	July 11	Aug. 25	No marked peak	1	9	5	3	32, 33

FAMILY ARCTIIDAE

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
AMMALO TENERA Hbn.	June 21	June 29			3	0	0	32, 33, 34
HALYSIDOTA MACULATA Harris.*	June 5	Aug. 29	June 25-July 8	1	102	29	27	31-34
H. TESSELLARIS A. & S.*	June 19	Aug. 31	July 12-31	1	1155	472	403	31-34

ARCTIIDAE—(Continued)

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
EUBAPHE AURANTIACA Hbn.	July 4	Aug. 18	No marked peak	1	16	0	0	32, 34
PHRAGMATOBIA FULIGINOSA L.*	May 9	Aug. 28	May 24-30; July 20-31	2	134	7	7	31-34
P. ASSIMILANS Wlk.	July 3				1	0	0	32
DIACRISIA VIRGINICA Fabr.*	May 27	Aug. 13	June 12-July 14	1	259	21	19	31-34
ISIA ISABELLA A. & S.*	June 1	Aug. 10	June 24-July 12	1	175	11	10	31-34
HYPHANTRIA TEXTOR Harr.*	June 2	Aug. 3	June 19-July 11	1	64	0	0	31-34
H. CUNEA Dru.*	June 7	Aug. 13	June 20-July 14	1	101	1	1	31-34
ESTIGMENE ACREAE Dru.*	May 24	Aug. 31	June 16-20; Aug. 20-28	2	231	19	18	31-34
E. PRIMA Slosson.	May 29				1			33
APANTESIS VIRGO L.*	July 9	Aug. 14	No marked peak	1	82	3	2	31-34
A. PARTHENICE Kby.	Aug. 20	Aug. 30			4	0	0	33
A. VIRGUNCULA Kby.	May 30	July 23	June 13-28	1	30	0	0	31-34
A. PHYLLIRA Dru.	June 26				2	0	0	33
EUCHAETIAS EGLE Dru.	June 25	July 12			2	0	0	31, 32
E. OREGONENSIS Stretch.	May 16	June 29	No marked peak	1	7	1	1	32, 33, 34
ARCTIA CAJA AMERICANA Harr.	July 27	Aug. 14	Aug. 6-12	1	31	6	4	32, 33, 34
HAPLOA CONFUSA Lyman.	July 13				1			34

FAMILY NOCTUIDAE

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
HELIOTHIS OBSOLETA Fabr.*	Sept. 11	Oct. 5	No marked peak		12	5	0	31, 34
RHODOPHORA FLORIDA Gn.	July 23	Aug. 13	No marked peak	1	15	2	2	31-34
LYGRANTHOECIA MARGINATA Haw.	July 31	Aug. 10			2	1	0	32, 33
EUXOA DETERSA Wlk.	Sept. 4	Sept. 17		1	7	1	1	31, 32, 34
E. VELLERIPENNIS Grt.	Aug. 15	Sept. 4		1	9	1	1	33, 34
E. MIMALLONIS Grt.	July 28	Aug. 27		1	5	0	0	31, 32, 34
E. MESSORIA Harr.*	Aug. 16	Sept. 11	No marked peak	1	28	7	4	33, 34
E. FUMALIS Grt.	Aug. 3	Sept. 6	No marked peak	1	29	8	5	33, 34
E. TESSELLATA Harr.*	July 14	Sept. 11	July 24-Aug. 6	1	42	14	12	31-34
E. DECOLOR Morr.	Aug. 21	Aug. 31		1	6	0	0	33-34
E. MOLLIS Wlk.	July 5				1			34

NOCTUIDAE—(Continued)

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
E. DIVERGENS Wlk.	June 25	Aug. 13	July 1-21	1	45	15	13	31-34
E. OBELISCOIDES Gn.	Aug. 12	Sept. 11		1	9	1	1	33, 34
E. REDIMICULA Morr.	July 5	Sept. 4	No marked peak	1	19	1	0	33, 34
E. OCHROGASTER Gn.	Aug. 30				1	0	0	33
FELTIA GLADIARIA Morr.*	Aug. 22	Sept. 25	Sept. 1-12	1	59	4	4	31-34
F. VENERABILIS Wlk.*	Aug. 27	Oct. 1	Sept. 7-21	1	775	56	52	31-34
F. DUCENS Wlk.*	July 30	Sept. 18	Aug. 14-Sept. 4	1	299	34	34	31-34
F. SUBGOTHICA Haw.*	July 24	Sept. 18	July 26-Aug. 29	1	63	20	18	31-34
F. HERILIS Grt.*	July 8	Sept. 11	Aug. 12-Aug. 30	1	302	26	26	31-34
F. VOLUBILIS Harv.	May 16	June 13	No marked peak	1	11	2	2	34
AGROTIS GENICULATA G. & R.	Aug. 8	Sept. 4			3	1	?	32, 34
A. OPACIFRONS Grt.	Aug. 8	Aug. 31			5	1	0	33, 34
A. YPSILON Rott.*	May 23	Oct. 6	May 27-June 10; July 14-Aug. 16	2	228	71	54	31-34
A. COLLARIS G. & R.	Aug. 22	Oct. 1	Sept. 1-18	1	46	8	8	31-34
A. C-NIGRUM L.*	June 14	Oct. 7	July 17-Aug. 21	1 or 2	488	102	76	31-34
A. BICARNEA Gn.*	July 20	Sept. 5	Aug. 8-22	1	69	15	13	31-34
A. NORMANIANA Grt.	July 31	Aug. 27	No marked peak	1	18	4	1	32, 33
A. BAJA SMITHII Snell.*	Aug. 1	Sept. 18	Aug. 16-Sept. 10	1	155	19	18	31-34
A. PLECTA L.*	June 13	Sept. 11	July 8-29	1	408	95	85	31-34
A. JUCUNDA Wlk.	July 11	July 18		1	4	2	2	31
A. PHYLLOPHORA Grt.	July 3	July 28		1	5	2	2	31-34
A. FENNICA Tausch.	Aug. 3	Sept. 24	Aug. 22-Sept. 9	1	14	4	0	33, 34
A. OBLATA Morr.	July 7				1	0	0	34
A. CLANDESTINA Harr.	June 19				2	0	0	34
EPISILIA SALICARUM Wlk.	May 2	May 23			8	1	0	32, 33
LYCOPHOTIA ASTRICTA Morr.	July 25	Aug. 18	Aug. 1-16	1	13	0	0	32, 33, 34
L. OCCULTA L.*	June 14	Sept. 30	Aug. 14-28	1	217	35	33	31-34
L. MARGARITOSA Haw.*	June 17	Oct. 16	No marked peak	2	157	32	23	31-34
L. LUBRICANS Gn.*	June 19	Oct. 1	Aug. 7-29	1	131	14	12	31-34
ANYTUS PRIVATUS Wlk.	Aug 12	Sept. 30	No marked peak	1	30	2	0	32, 33, 34
MATUTA ELIMATA Gn.	Aug. 19	Sept. 13	Aug. 25-Sept. 4	1	23	8	7	31-34
M. YOUNGI Sm.*	July 21	Sept. 30	July 29-Aug. 28	1	60	20	15	31-34
M. PRASINA Fabr.*	July 9	Sept. 13	July 21-Aug. 20	1	178	38	21	31-34
RHYNCHAGROTIS RUFIPECTUS Morr.	Aug. 11	Sept. 4			2	1	1	32, 33
R. ALTERNATA Grt.	July 2	Aug. 30			7	2	1	32, 33, 34
R. CUPIDA Grt.	Aug. 8				1	0	0	32
R. GILVIPENNIS Grt.	July 21	Aug. 5			7	1	0	32, 33, 34
EURETAGROTIS PERATTENTA Grt.	June 29	Aug. 8		1	13	3	1	32, 33

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
SCOTOGRAMMA TRIFOLII Rott.*	June 2	Sept. 12	June 13-28; Aug. 7-30	2	47	13	10	31-34
POLIA LUSTRALIS Grt.	June 22	July 3			2	0	0	32, 33
P. IMBRIFERA Gn.	July 6	Aug. 7	July 15-29		46	0	0	32, 33, 34
P. PURPURISSATA Grt.*	July 27	Sept. 6	Aug. 8-25	1	184	41	41	31-34
P. MEDITATA Grt.	Aug. 8	Aug. 27		1	9	1	1	33, 34
P. GRANDIS Bdv.	June 3	July 17	June 14-July 3	1	24	6	6	32, 33, 34
P. SUBJUNCTA G. & R.*	May 28	Sept. 13	July 5-29	1	189	40	36	31-34
P. CRISTIFERA LUBENS Grt.	June 18	July 11	June 26-July 5	1	27	11	11	31-34
P. LATEX Gn.	June 22	June 26			2	1	0	33, 34
P. NIMBOSA Gn.	July 5	July 27			14	1	1	33, 34
P. ADJUNCTA Bdv.	May 30	Aug. 21	June 14-June 25	1	46	2	2	33, 34
P. TACOMA Stkr.	June 2	July 5	No marked peak	1	21	0	0	31-34
P. ATLANTICA Grt.*	May 30	Aug. 1	June 13-July 6	1	234	26	22	31-34
P. RADIX Wlk.	June 30				1	0	0	33
P. LEGITIMA Grt.*	June 3	Aug. 9	July 1-22	1	419	47	45	31-34
P. LILACINA Harv.*	June 8	Aug. 13	June 20-July 19	1	228	10	7	31-34
P. ASSIMILIS Morr.*	June 15	July 31	June 22-July 16	1	99	7	7	31-34
P. ANGUINA Grt.	June 23				2	0	0	33
P. RENIGERA Steph.*	June 28	Sept. 5	Aug. 9-26	1	496	53	52	31-34
P. LOREA Gn.*	June 18	July 24	June 25-July 8	1	118	8	8	31-34
P. OLIVACEA Morr.*	July 11	Sept. 14	Aug. 9-30	1	188	42	33	31-34
CHABUATA SIGNATA Wlk.*	Aug. 2	Sept. 6	Aug. 10-22	1	61	15	14	32, 33, 34
HYSSIA MODESTA Morr.	Aug. 26				1	0	0	34
ERIOPYGA OVIDUCA Gn.	May 24	July 12	No marked peak	1	14	4	4	31, 32, 33
E. CRENULATA Butl.*	July 1	Aug. 19	July 17-Aug. 6	1	60	9	7	32, 33, 34
E. CYNICA Gn.	May 5	Aug. 8	No marked peak	1	22	3	2	32, 33, 34
E. VECORS Gn.	June 30	Aug. 7	No marked peak	1	13	1	1	33, 34
E. FURFURATA Grt.	July 13				1	0	0	33
NEPHELODES MINIANS Gn.*	Aug. 18	Sept. 29	Aug. 27-Sept. 15	1	531	13	13	31-34
XYLOMIGES DOLOSA Grt.	May 17				2	0	0	33
ORTHOSIA HIBISCI Gn.*	May 9	May 29	May 14-23	1	588	211	198	32, 33, 34
SIDERIDIS ROSEA Harv.	May 17	June 26	No marked peak	1	18	3	3	31, 33, 34
S. NORMANI Grt.	May 7	June 4	No marked peak		10	2	2	31, 33, 34
S. RUBEFACTA Morr.	July 26	Sept. 9	No marked peak		12	3	3	33, 34
CERAMICA PICTA Harr.*	May 19	Aug. 29	June 12-24; Aug. 1-20	2	196	12	12	31-34
CIRPHIS PSEUDARGYRIA Gn.	July 2	Aug. 7	July 9-25	1	39	13	10	31-34
C. MULTILINEA Wlk.	June 18	Sept. 17	No marked peak	1	29	6	5	33, 34
C. COMMOIDES Gn.*	July 1	Aug. 7	July 8-28	1	255	19	14	31-34

NOCTUIDAE—(Continued)

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
C. PHRAGMATIDICOLA Gn.*	July 18	Aug. 11	July 13-27	1	153	16	16	31-34
C. INSUETA Gn.	June 2	July 30	July 10-20	1	469	49	42	31-34
C. UNIPUNCTA Haw.*	May 12	Oct. 13	No marked peak	2	947	428	191	31-34
BOROLIA LINITA Gn.	June 14	June 27			3	0	0	32
NELEUCANIA ALBILINEA DIFFUSA Wlk.*	May 26	Sept. 3	June 2-22; Aug. 1-20	2	436	57	52	31-34
LEUCANIA LUTEOPALLENS Sm.*	June 21	Sept. 10	July 14-30	1	354	23	21	31-34
CUCULLIA INTERMEDIA Speyer*	May 16	Sept. 13	No marked peak	2	219	35	34	31-34
C. FLOREA Gn.	May 12	July 11	No marked peak		8	1	1	32, 33, 34
C. CONVEXIPENNIS G. & R.	June 21	Aug. 19	No marked peak	1	25	1	1	32, 33, 34
ONCOCNEMIS PIFFARDI Wlk.	Aug. 26	Sept. 23			3	0	0	32, 34
FERALIA MAJOR Sm.	May 2	May 23			6	0	0	32, 33
MOMOPHANA COMSTOCKI Grt.	May 23				2	1	0	33
LITHOLOMIA NAPAEA Morr.	Aug. 16	Sept. 18			7	0	0	34
HILLIA ALGENS Grt.	Aug. 10	Sept. 3	No marked peak	1	32	11	11	32, 34
GRAPTOLITHA BETHUNEI G. & R.	May 14	Sept. 24			8	2	2	33, 34
G. PEXATA Grt.	Sept. 12				1	0	0	33
XYLENA NUPERA Lint.	May 5	May 19			6	0	0	32, 34
X. CURVIMACULA Morr.	May 6	May 27			4	1	?	34
X. CINERITIA Grt.	May 2	May 15			3	1	0	34
EPIGLAEA APIATA Grt.	Sept. 7	Sept. 25			10	3	3	34
PSECTRAGLAEA CARNOSA Grt.	Sept. 24				1	0	0	34
CONISTRA INULTA Grt.	Oct. 2				1	0	0	31
C. TRISTIGMATA Grt.	May 6				1	0	0	34
PARASTICHTIS BICOLORAGO Gn.	Sept. 10	Oct. 5	No marked peak		24	3	0	31-34
P. PUTA G. & R.	July 12				1	0	0	34
ATETHMIA PAMPINA Gn.	Sept. 1	Sept. 4			2	0	0	31, 33
XANTHIA LUTEA Strom.	Sept. 24	Oct. 2			6	1	1	33, 34
AMPHIPYRA PYRAMIDOIDES Gn.	Aug. 7	Sept. 18			10	1	0	32, 33, 34
A. TRAGOPOGINIS L.	July 19	Sept. 11		1	12	3	3	32, 33, 34
MAGUSA ORBIFERA Wlk.	Aug 1	Aug. 8			5	3	0	32, 33
DIPTERYGIA SCABRIUSCULA L.	July 9				2	0	0	34
SEPTIS VERBASCOIDES Gn.*	June 29	Aug. 20	July 17-31	1	74	55	51	31-34
S. LIGNICOLOR Gn.*	June 18	Aug. 2	July 16-31	1	155	45	45	31-34
S. APAMIFORMIS Gn.	July 17	July 31		1	6	4	3	31, 34
S. ARCTICA Boisd.*	June 20	Sept. 9	July 14-Aug. 8	1	233	180	169	31, 34
S. SUFFUSCA Morr.	July 1	July 23	No marked peak	1	32	26	23	31-34
S. RORULENTA Sm.	June 28	July 23	No marked peak	1	13	8	8	31, 32, 34
TRACHEA ILLOCATA Wlk.	Sept. 10	Sept. 14		1	8	5	4	31, 34

NOCTUIDAE—(Continued)

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
T. REMISSA INDOCILIS Wlk.	July 3	July 17		1	7	1	1	31, 34
T. FINITIMA Gn.*	June 2	July 12	June 10-July 5	1	119	98	92	31-34
T. MODICA Gn.	Aug. 4	Aug. 27		1	9	1	1	32, 33, 34
T. IMPULSA Gn.	June 19	Aug. 12	No marked peak	1	49	25	21	31-34
EUPLEXIA LUCIPARA L.	June 18	June 25			2	0	0	34
OLIGIA BRIDGHAMI G. & R.	July 12	Sept. 4	July 21-Aug. 18	1	85	20	17	32, 33, 34
O. FRACTILINEA Grt.	July 19	Aug. 26	Aug. 12-24	1	30	20	16	32, 33, 34
O. DIVERSICOLOR Morr.*	Aug. 17	Oct. 2	Aug. 24-Sept. 11	1	125	13	13	31-34
AGROPERINA DUBITANS Wlk.*	July 12	Sept. 15	Aug. 8-29	1	85	21	21	31-34
A. COGITATA Sm.*	June 27	July 29	July 7-24	1	62	11	11	31-34
A. LATERITIA Hufn.	June 28	Aug. 11		1	8	5	2	31, 34
EREMOBIA CLAUDENS Wlk.	Aug. 7	Aug. 21			2	1	0	33, 34
MACRONOCTUA ONUSTA Grt.	Aug. 14	Sept. 17		1	10	1	1	33, 34
SIDEMIA DEVASTATRIX Brace.*	June 26	Sept. 12	July 20-Aug. 24	1	554	66	64	31-34
LUPERINA STIPATA Morr.	Aug. 8	Sept. 25	Aug. 27-Sept. 13	1	24	1	1	32, 33, 34
LUPERINA PASSER Gn.	July 2	Aug. 7		1	12	1	1	31, 32, 34
PHLOGOPHORA IRIS Gn.*	June 1	Aug. 6	June 18-30	1	78	42	39	31-34
CHUTAPHA PERICULOSA Gn.	July 11	Sept. 4	No marked peak	1	17	0	0	31-34
CALLOPISTRIA MOLLISSIMA Gn.	June 23				1	0	0	33
C. MONETIFERA Gn.	July 2	July 31			8	4	3	33, 34
HARRISIMEMNA TRISIGNATA Wlk.	June 7				1	0	0	34
LEUCONYCTA DIPHTEROIDES Grt.	June 16	July 3			6	2	2	32, 34
ACRONYCTA VINNULA Grt.	July 8	July 9			2	0	0	34
A. TRISTIS Sm.	July 7	July 12			2	0	0	33, 34
A. NOCTIVAGA Grt.	June 3				1	0	0	33
A. HASTA Gn.	June 7	June 24			3	0	0	34
A. GRISEA Wlk.	June 30				1	0	0	33
A. MORULA G. & R.	June 4	July 17	No marked peak	1	18	2	2	32, 34
A. LEPORINA L.	July 19				1	0	0	34
A. INNOTATA Gn.	July 2	Aug. 8			4	0	0	33, 34
A. AMERICANA Harr.	July 9	July 22			3	2	2	33, 34
A. DACTYLINA Grt.*	June 16	Aug. 5	July 6-28	1	32	4	4	32, 33, 34
A. IMPRESSA Wlk.	June 24	Aug. 8			3	1	1	32, 33
A. DISTANS Grt.	May 23				1	0	0	33
ARSILONCHE ALBOVENOSA HENRICI Grt.*	May 14	Aug. 29	May 20-June 10; July 21-Aug. 12	2	147	9	7	31-34
DELTA RAMOSULA Gn.	July 3	Aug. 26	July 24-Aug. 16	1	19	1	1	32, 33, 34
HYPPA XYLINOIDES Gn.*	May 19	Sept. 21	June 10-20; Aug. 20-Sept. 8	2	192	55	52	31-34

NOCTUIDAE—(Continued)

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
PRODENIA ORNITHOGALLI Gn.*	Sept. 1	Sept. 25			6	0	0	31, 33, 34
LAPHYGMA FRUGIPERDA A. & S.*	Oct. 5				3	0	0	31
CARADRINA MULTIFERA Wlk.	Sept. 13	Sept. 30			5	0	0	33, 34
HELOTROPHA RENIFORMIS Grt.	Aug. 4	Oct. 7	Aug. 17-Sept. 20	1	46	18	14	31-34
APAMEA VELATA Wlk.*	July 7	Aug. 29	July 20-31	1	712	338	304	31-34
A. NICTITANS AMERICANA Speyer.*	July 14	Oct. 6	Aug. 10-28	1	1774	242	213	31-34
GORTYNA MICACEA Esp.*	July 12	Sept. 17	Aug. 1-20	1	597	21	19	31-34
PYRRHIA UMBRA Hufn.	July 3	Aug. 6			6	1	1	33, 34
PAPAIPEMA INQUAESITA G. & R.*	Aug. 21	Oct. 2	Sept.1-18	1	18	3	1	31-34
P. MARGINIDENS Gn.	Sept. 3	Sept. 28		1	6	2	0	31-34
P. NEPHELEPTENA Dyar.	Sept. 27			1	2	0	0	34
P. PURPURIFASCIA G. & R.	Sept. 9	Sept. 30		1	8	3	2	31-34
P. LYSIMACHIAE Bird.	Sept. 11			1	1	0	0	34
P. PTERISII Bird.	Sept. 11	Oct. 6		1	12	3	3	31-34
P. FRIGIDA Sm.	Sept. 2	Sept. 30		1	23	8	7	31-34
P. NEBRIS NITELA Gn.	Sept. 11	Sept. 24		1	6	2	2	31, 34
OGDOCONTA CINEREOLA Gn.	July 5	Sept. 10			2	1	1	31, 33
IPIMORPHA PLEONECTUSA Grt.	Aug. 5				2	2	?	32
ENARGIA DECOLOR Wlk.	July 30	Sept. 16			10	2	2	32, 33, 34
ARZAMA OBLIQUA Wlk.	June 3	June 18			8	2	2	33, 34
CALAMIA INQUINATA Gn.	July 2				2	1	?	34
LITHACODIA CARNEOLA Gn.	June 9	June 18			2	0	0	33, 34
L. APICOSA Haw.	July 5	Sept. 2			11	4	4	31, 33
CRYPHIA PERVENTENS B. & McD.	July 21				1	0	0	33
CATOCALA ANTINYMPHA Hbn.	July 27	Sept. 6	Aug. 7-21	1	28	0	0	33, 34
C. COELEBS Grt.	July 25	Aug. 13		1	5	0	0	33, 34
C. CEROGAMA Gn.	Aug. 8	Sept. 6		1	4	0	0	33, 34
C. RELICTA Wlk.	Aug. 9	Sept. 14		1	16	2	1	31-34
C. PARTA Gn.	Aug. 12	Sept. 11		1	2	0	0	33, 34
C. BRISEIS Edw.	Sept. 4	Sept. 11		1	3	0	0	33, 34
C. UNIJUGA Wlk.	Aug. 8	Aug. 21		1	3	0	0	33, 34
C. CONCUMBENS Wlk.	Aug. 13	Sept. 13	Aug. 16-Sept. 7	1	78	7	6	32, 33, 34
C. ULTRONIA Hbn.	Aug. 2	Sept. 7		1	5	0	0	33, 34
C. CRATAEGI Saund.	July 29			1	2	0	0	34
C. PRAECLARA G. & R.	July 30	Aug. 13		1	6	0	0	33, 34
EUPARTHENOS NUBILIS Hbn.	June 14	Sept. 10	July 1-16; Aug. 22-31	2	18	3	3	31-34
PARALLELIA BISTRIARIS Hbn.	June 20	July 23		1	6	0	0	32, 33, 34
EUCLIDIA CUSPIDEA Hbn.	June 27	July 9			3	0	0	34

NOCTUIDAE—(Continued)

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
CAENURGIA ERECHTEA Cram.*	May 11	Sept. 30	May 22-June 5; July 27-Aug. 20	2	5240	344	315	31-34
C. CRASSIUSCULA Haw.*	May 11	Sept. 30	May 22-June 5; July 27-Aug. 20	2				31-34
ZALE HORRIDA Hbn.	May 30				1	0	0	34
PANTHEA ACRONYCTOIDES Wlk.	July 21				1	0	0	33
P. FURCILLA Pack.	July 30	Aug. 21			4	1	0	32, 33
CHARADRA DERIDENS Gn.	June 3	June 30			2	0	0	34
AUTOGRAPHA FALCIGERA Kirby*	May 26	Oct. 3	June 23-July 10; July 24-Aug. 20	2	644	41	20	31-34
A. EPIGAEA Grt.	Aug. 11				3	0	0	34
A. RECTANGULA Kirby	July 10	Aug. 12	July 22-30	1	22	12	2	31-34
A. ALIAS Ottol.	July 13	Aug. 1		1	3	0	0	33
A. OCTOSCRIPTA Grt.	July 30	Sept. 4	Aug. 5-28	1	19	6	2	32, 33, 34
A. BRASSICAE Riley*	June 30	Sept. 18	No marked peaks	2	29	5	1	32, 33, 34
A. OXYGRAMMA Geyer	Sept. 4	Sept. 11		1	5	0	0	31, 34
A. PUTNAMI Grt.*	June 7	Sept. 27	June 20-July 18; Aug. 24-Sept. 14	2	122	10	10	31-34
A. CONTEXTA Grt.*	June 11	Sept. 28	June 18-July 6; Aug. 10-Sept. 6	2	164	17	15	31-34
A. BILOBA Steph.	June 7	Sept. 4	No marked peak		13	1	0	31-34
A. OO Cram.	July 13				1	0	0	34
A. PRECATIONIS Gn.*	May 29	Oct. 7	June 5-26; Aug. 18-Sept. 15	2	435	87	67	31-34
A. BIMACULATA Steph.	July 14	Aug. 16		1	21	2	1	31-34
A. MAPPA G. & R.	July 19				1	0	0	34
A. AMPLA Wlk.	July 1	Sept. 8		1	32	2	2	32, 33, 34
PLUSIA AEREOIDES Grt.*	June 26	Aug. 8	July 14-31	1	141	17	12	31-34
P. BALLUCA Geyer	July 6	Aug. 19	July 17-Aug. 14	1	29	1	1	31-34
EOSPHOROPTERYX THYATYROIDES Gn.	July 19	Aug. 10			4	0	0	34
PSEUDEVA PURPURIGERA Wlk.	July 18	July 23			2	0	0	34
PALAEOPLUSIA VENUSTA Wlk.	June 29	Aug. 25	July 9-Aug. 8	1	23	2	2	31-34
RAPHIA FRATER Grt.	June 2	Aug. 9	July 10-24	1	44	13	7	31-34
CALPE CANADENSIS Beth.	June 24	July 30			3	0	0	33, 34
SCOLIOPTERYX LIBATRIX L.	June 18	July 27		1	8	4	3	32, 33, 34
ALABAMA ARGILLACEA Hbn.*	Sept. 20	Oct. 2	Sept. 21-28		156	81	72	33, 34
PLATHYPENA SCABRA Fabr.	Oct. 2	Oct. 5			4	0	0	31

FAMILY NOTODONTIDAE

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
ICHTHYURA APICALIS Wlk.*	June 2	July 30	June 7-30	1	42	1	1	32, 33, 34
I. STRIGOSA Grt.	June 19	June 22		1	2	0	0	33
I. ALBOSIGMA Fitch*	May 23	Aug. 20	No marked peak		40	2	0	32, 33, 34
DATANA MINISTRA Dru.*	June 15	Aug. 14	June 20-July 18	1	63	0	0	31-34
D. DREXELII Hy. Edw.	June 30	July 7		1	3	0	0	32
HYPERAESCHRA STRAGULA Grt.	June 2	Aug. 21			7	1	1	32, 33, 34
NOTODONTA BASITRIENS Wlk.	July 8	July 23			5	0	0	33, 34
PHEOSIA DIMIDIATA H.-S.*	May 14	Aug. 31	May 22-June 12; Aug. 14-28	2	66	2	2	31-34
LOPHODONTA FERRUGINEA Pack.*	June 12	Aug. 14	July 16-31	1	103	7	6	31-34
L. ANGULOSA A. & S.	July 26				1	0	0	33
NADATA GIBBOSA A. & S.	July 1	Aug. 18		1	8	0	0	34
NERICE BIDENTATA Wlk.	June 4	Aug. 13			4	0	0	32, 33, 34
SYMMERISTA ALBIFRONS A. & S.	June 9	July 22	July 1-19	1	15	1	1	32, 33, 34
HETEROCAMPA UMBRATA Wlk.	July 11	July 12			2	0	0	32
H. GUTTIVITTA Wlk.	May 22	June 20			8	0	0	33, 34
H. BILINEATA Pack.	June 5	July 28			5	0	0	31-34
H. BIUNDATA Wlk.	June 18	July 14			3	0	0	33, 34
IANASSA LIGNICOLOR Wlk.	July 12	Aug. 5			7	0	0	31-34
SCHIZURA SEMIRUFESCENS Wlk.	June 20	July 31	July 10-31	1	12	1	1	33, 34
S. IPOMOEAE Dbldy.	July 7	July 21			2	0	0	33, 34
S. BADIA Pack.	July 8				1	0	0	34
S. UNICORNIS A. & S.	July 11	Aug. 20		1	10	0	0	33, 34
CERURA BOREALIS Bdv.	July 10				1	0	0	34
C. OCCIDENTALIS Lint.	July 12	July 21			2	0	0	33, 34
C. SCOLOPENDRINA MODESTA Hud.	Aug. 14				1	0	0	33
FENTONIA MARTHESIA Cram.	July 1	Aug. 27	July 5-30	1	14	0	0	31-34
GLUPHISIA SEPTENTRIONALIS Wlk.*	May 19	Aug. 4	No marked peaks	2	151	2	2	31-34
G. LINTNERI AVIMACULA Hud.	May 19	May 29			3	1	?	31, 32, 33
G. LINTNERI SEVERA Hy. Edw.	May 23				1	0	0	33

Family Thyatiridae

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
HABROSYNE SCRIPTA Gosse*	June 1	Aug. 18	June 13-28; July 19-Aug. 12	2	107	42	40	32, 33, 34
PSEUDOTHYATIRA CYMATOPHOROIDES Gn.*	June 18	Aug. 7	July 1-29	1	75	8	7	32, 33, 34

Family Lymantriidae

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
HEMEROCAMPA LEUCOSTIGMA S. & A.*	Aug. 2	Sept. 14	Aug. 23-Sept. 10	1	56	0	0	31-34
OLENE VAGANS B. & McD.	July 8			1	1	0	0	34
O. PLAGIATA Wlk.*	June 27	Aug. 12	July 5-26	1	131	22	17	31-34
PORTHETRIA DISPAR L.*	July 18	Aug. 1		1	8	0	0	32, 33
EUPROCTIS CHRYSORRHOEA L.*	July 10	July 27	July 12-25	1	84	1	1	31, 32, 33
STILPNOTA SALICIS L.*	June 26	Aug. 14	July 7-27	1	739	172	170	31-34

Family Lasiocampidae

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
TOLPE VELLEDA Stoll.	Aug. 31	Sept. 23	Sept. 2-20	1	25	0	0	32, 33, 34
MALACOSOMA AMERICANA Fabr.*	June 29	Aug. 3	July 8-21	1	456	95	12	31-34
M. DISSTRIA Hbn.*	July 1	Aug. 30	July 8-21	1	8484	2949	1521	31-34

FAMILY DREPANIDAE

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
DREPANA ARCUATA Wlk.*	May 19	Aug. 29	May 30-June 27; July 20-Aug. 13	2	176	4	3	31-34
D. BILINEATA Pack.	May 18	Aug. 21	No marked peaks	2	24	1	1	31-34

FAMILY GEOMETRIDAE

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
SYNCHLORA RUBRIFRONTARIA Pack.	June 6	June 20	June 12-20	1	21	4	4	32, 33, 34
CALOCALPE UNDULATA L.	June 20	Aug. 13			7	4	4	31, 32, 34
EAROPHILA VASILIATA Gn.	May 27				1	0	0	34
CABERA VARIOLARIA Gn.	June 6	July 24	No marked peak	1	17	1	1	31, 32, 34
MACARIA MELLISTRIAGATA Grt.	May 20	June 11			3	0	0	31, 34
APAECASIA SUBAEQUARIA Wlk.	June 3	June 19			7	0	0	33, 34
CARIPETA DIVISATA Wlk.	July 23	Aug. 10		1	11	3	3	31-34
C. ANGUSTIORATA CRIMINOSA Swett.	June 20	Aug. 6	No marked peak	1	12	2	2	
NEPYTIA CANOSARIA Wlk.*	Sept. 3	Sept. 28	Sept. 17-28	1	65	12	12	31-34
LYCIA URSARIA Wlk.	May 14				2	0	0	34
L. COGNATARIA Gn.*	May 12	Aug. 23	July 14-Aug. 6	1	446	11	7	31-34
NACOPHORA QUERNARIA A. & S.	June 12	June 26			2	0	0	33
ERANNIS TILIARIA Harris.	Oct. 2	Oct. 14		1	5	0	0	31
CINGILIA RUBRIFERARIA Swett.*	Sept. 4	Sept. 28	Sept. 12-28	1	4482	72	72	31-34
ELLOPIA FISCELLARIA Gn.	Aug. 19	Sept. 26	Sept. 10-24	1	14	11	11	31-34
CAMPAEA PERLATA Gn.*	June 18	Sept. 5	June 18-July 3; Aug. 21-Sept. 4	2	84	33	33	31-34
ENNOMOS MAGNARIUS Gn.	Aug. 8	Oct. 3	Sept. 12-30	1	83	1	1	31-34
XANTHOTYPE CROCATARIA Fabr.*	June 25	Aug. 5	July 1-29	1	74	0	0	32, 33, 34
METARRANTHIS WARNER Harv.	May 28	June 12		1	12	2	1	31-34
EUCHLAENA SERRATA Dru.	July 5	July 24		1	9	0	0	33, 34
E. OBTUSARIA Hbn.	July 9	July 26		1	5	1	0	34
E. EFFECTA Wlk.	July 1	June 11		1	2	0	0	34
METANEMA DETERMINATA Wlk.	June 29				2	0	0	34
PERO HONESTARIUS Wlk.*	June 5	July 7	June 21-July 2	1	55	3	3	31-34
APICIA CONFUSARIA Hbn.	July 5	July 22	July 11-July 22	1	20	3	3	31-34
SABRULODES LORATA Grt.	June 5	July 1		2	5	0	0	32, 34
S. TRANSVERSATA Drury.*	July 17	Oct. 1	No marked peak	2	93	5	5	31-34

FAMILY EUCLEIDAE

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
EUCLEA DELPHINII Bdv.*	June 26	July 10		1	7	0	0	33, 34

FAMILY PYRALIDAE

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
PANTOGRAPHA LIMATA G. & R.*	July 9	Aug. 21	July 14-27	1	29	3	3	32, 33, 34
NOMOPHILA NOCTUELLA Schiff*	May 11	Oct. 9	July 15-30; Aug. 16-31	2	11,424	4,670	3,969	31-34
EURRHYPARA URTICATA L.	June 6	Aug. 8	June 22-July 19	1	147	26	22	31-34

FAMILY TORTRICIDAE

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
CACOECIA CONFLICTANA Wlk.	June 3	June 29		1	14	6	6	34

FAMILY COSSIDAE

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
ACOSSUS CENTERENSIS Lint.	June 18	June 28		1	2	1	?	31, 32

FAMILY HEPIALIDAE

Species	First Adults	Last Adults	Period of Maximum Flight	Probable No. of Broods	Total Catch	Total Females	Gravid Females	Years of Capture
STHENOPSIS ARGENTEOMACULATUS Harris.	June 16			1	1	0	0	32

A LIST OF RARE AND UNUSUAL RECORDS OF SPECIES CAPTURED AT ORONO, MAINE, 1931-1934, INCLUSIVE

The writer is indebted to Dr. D. W. Farquhar,[2] a specialist upon the distribution of Lepidoptera in New England, for the following comments made upon a number of rare or unusual species captured during this study.

Protoparce rustica Fabr.—"Except for the reference in Holland's Moth Book I have seen no records of other New England captures of this stray."

Ceratomia catalpae Bdv.—"A Sphingid I have never seen farther north than New Jersey and Long Island. The specimen doubtless is an accidental introduction. . . . perhaps blown up by high winds."

Samia columbia Sm.—"Orono is near the southern limit of its range."

Ammalo tenera Hbn.—"Reported also from Lincoln, Maine."

Phragmatobia assimilans Wlk.—"Rare. First Maine record."

Apantesis phyllira Dru.—"First Maine records I have seen."

Euchaetias oregonensis Stretch.—"Have seen this abundant in Massachusetts, but only record from Maine is in the southern tip, Kittery. Only one New Hampshire record, too—Webster."

Euxoa velleripennis Grt.—"Second Maine record. Taken also at Kittery Point."

Euxoa decolor Morr.—"A very rare species."

Euxoa mollis Wlk.—"Seems limited in New England to northern Maine."

Euxoa obeliscoides Gn.—"Many Massachusetts records, but only other Maine record is for Kittery Point."

Agrotis fennica Tausch.—"Not common. Taken at Kittery and Lincoln, Maine."

Agrotis oblata Morr.—"A northern species. Bath, Maine, is only other New England record."

Rhynchagrotis rufipectis Morr.—"Very rare. Has been taken at Kittery Point, Maine."

Rhynchagrotis alternata Grt.—"First Maine record. Taken in New Hampshire, Rhode Island, Connecticut, and Massachusetts."

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[2] A graduate student at Harvard University while this study was in progress. The comments were made in correspondence during May, 1935.

Rhynchagrotis cupida Grt.—"Extremely rare."
Polia latex Gn.—"First Maine record I have seen."
Polia tacoma Stkr.—"Second New England record—The other record is at Enfield, Maine."
Polia radix Wlk.—"First New England record I have seen."
Polia anguina Grt.—"Rare. Second Maine record—Also taken at Bar Harbor."
Eriopyga oviduca Gn.—"Only Maine record. Many records for Massachusetts, Rhode Island, and Connecticut."
Xylomiges dolosa Grt.—"Original description is from a Fernald specimen at Orono, Maine."
Cirphis phragmatidocola Gn.—"Only Maine record. Several records for Massachusetts, Rhode Island, and Connecticut."
Borolia linita Gn.—"A rare species."
Cuculia florea Gn.—"Second New England record—Recorded also at Bar Harbor, Maine."
Oncocnemis piffardi Wlk.—"Known only from Maine in New England; Orono, Mt. Desert, Ironbound Island, and Lincoln."
Feralia major Sm.—"First Maine record."
Momophana comstocki Grt.—"Second New England record I have seen."
Hillia algens Grt.—"In Maine taken at Orono and Kittery Point."
Xylena nupera Lint.—"First Maine record."
Magusa orbifera Wlk.—"Doubtless a stray from the south."
Trachea impulsa Gn.—"Very rare in Connecticut. In Maine at Norway and Kittery Point."
Eremobia leucoscelis Grt.—"Second New England record. At Sherborn, Massachusetts."
Acronycta hasta Gn.—"Only Maine record I have seen; several for Massachusetts, New Hampshire, Rhode Island, and Connecticut."
Gortyna micacea Esp.—"Orono and Lincoln, Maine, are my only New England records for this species."
Pyrrhia umbra Hubn.—"First Maine record I have seen; have several from Massachusetts, Vermont, Rhode Island, and Connecticut."
Papaipema purpurifascia G. & R.—"First Maine record."
Papaiema nebris Gn. form *nitela* Gn.—"First Maine record, many for Massachusetts, Rhode Island, and Connecticut."
Cryphia pervertens B. & McD.—"First Maine record."

Euparthenos nubilis Hbn.—"Only Maine record. Common where locust grows."

Panthea acronyctoides Wlk.—"Second New England record."

Autographa mappa G. & R.—"Rare."

Autographa flagellum Wlk.—"An extremely interesting record. I have never seen a U. S. record for this Canadian species before."

Datana drexelii Hy. Edw.—"Only Maine record I have seen."

Notodonta basitriens Wlk.—"Very rare. Only New England records are three New Hampshire records and Kittery, Maine."

Gluphisia lintneri Grt. form *avimacula* Hub. and

G. severa Hy. Edw.—"Both are the only Maine records. Only other New England record is that of Goodhue at Webster, N. H., where he reported it rare."

Olene plagiata Wlk.—"Only record for New England except one in Connecticut."

Synchlora rubrifrontaria Pack.—"Not common."

Eurrhypara urticata Linn.—"Now extends into Southern New Hampshire."

Acossus centerensis Lint.—"Only Maine record I have seen."

LIFE CYCLES DEDUCED FROM THE RECORDS

At least 120 species were captured in sufficiently large numbers during one or more of the years to definitely establish in most instances the number of generations or broods per season and the time of adult activity. The results of this part of the study are presented in considerable detail, since the primary purpose was to accumulate information upon the life histories of moths found in Maine. A number of the species are discussed here because of their unusual importance as insect pests even though they may not have been taken in abundance. In addition to the light-trap data gathered by the writer, the general geographic distribution and the food plants of the species are given. Frequent use has been made of the writings of Smith (1899), Dyar (1902), Holland (1903), Forbes (1923 and 1926), Seitz (1923) and others in the compilation of the list of food plants and distribution of the species. Citations to these works have often been omitted to avoid needless repetition.

The seasonal occurrence of many species are presented in graph or chart form. In the charts, the total number of moths captured each week is indicated by a column denoting the percentage of the total captures for the season. The total number of moths captured each year is given also on the chart. A small circle on the graph is used to represent a single specimen.

FAMILY SPHINGIDAE

The members of this family are generally easily recognized by their long, narrow fore wings, by their stout abdomen with the segments gradually tapering, and by their modest, yet attractive coloration. The moths are of medium or large size and are commonly called hawkmoths on account of their powerful flight.

During 1931 to 1934, 407 individual moths, representing 14 species of Sphingidae, were taken at lights. The members of a few species were obtained in only limited numbers. However, specimens of 8 species were captured in such quantities as to show, to a fair degree at least, the period in the summer during which the adults are on the wing. None of the species obtained are important economic pests in Maine.

GENUS *Sphinx* LINNAEUS

Sphinx chersis Hbn. Great Ash Sphinx.

The food-plants of this species are lilac, ash, and privet.

The moth is found from Canada to Georgia and westward to California, according to Beutenmüller (1895, p. 304).

This moth was taken frequently from mid-July until early August. The records of the writer indicate one brood. Two broods occur southward. *S. chersis* came to lights each year of this study and a total of 43 specimens were secured. Among the moths were 9 gravid females.

Sphinx kalmiae Abbot and Smith. The Laurel Sphinx.

This species feeds in the larval stage upon the leaves of ash, lilac, and mountain laurel (*Kalmia latifolia*), according to Fernald (1885, p. 41). Beutenmüller (1895, p. 301) adds privet and *Chionanthus* to this list.

S. kalmiae has a wide distribution from Canada southward to Georgia and westward to Missouri.

Specimens of this moth were captured each year except 1931. One brood during July and August seems evident from the seasonal occurrence of the 13 moths secured.

Sphinx gordius Cramer. The Gordian Sphinx.

The larva feeds upon a number of trees and shrubs, including apple, pear, ash, sweet fern, huckleberry, and wax-myrtle (*Myrica*).

The species ranges over all the United States east of the Rocky Mountains, from New England to Georgia. It also is found in Canada.

In 1933, 29 specimens of *S. gordius* were secured during June and July. Fewer were taken in 1932 and 1934. All observations by the writer indicate one brood at Orono. Among the total captures of 46 individuals were 4 gravid females.

Sphinx drupiferarum Abbot and Smith.

The food-plants of the larva are apple, plum, and cherry.

The distribution of *S. drupiferarum* is practically identical with that of *S. gordius*.

This moth was taken only in 1931. That year 8 individuals were captured during late June and July.

Genus *Lapara* Walker

Lapara bombycoides Walker. The Pine Tree Sphinx.

The larva feeds upon various species of pine.

L. bombycoides is found from Canada to Florida and westward to the Mississippi, according to Holland (1903, p. 53).

The period of flight of this Sphingid was observed to extend from June 12 until July 28. All of the 27 moths captured except 1 were males. It seems evident that there is only one brood.

Genus *Smerinthus* Latreille

Smerinthus jamaicensis geminatus Say. The Twin-spotted Sphinx.

The larvae of the twin-spotted sphinx feed upon a wide variety of trees and shrubs which include cherry, plum, apple, hazel, hornbeam, ash, birch, willow, and poplar.

The species is found from Canada to Virginia and westward to Iowa and Kansas.

This moth was one of the most common of the Sphingidae at lights. The period of flight began in late May and extended until early August. Most of the captures were made in June and July and only straggling numbers of moths were observed early in May and again at the end of the period of flight in August. In 1932, although 35 individuals were secured, the records indicate but one brood. Fewer specimens were taken the other three years, and in no case do the captures suggest two full broods.

In southern New York conditions, Beutenmüller (1895, p. 315) found the twin-spotted sphinx to have two broods.

There were only 5 females among the total of 80 moths obtained.

GENUS *Paonias* HÜBNER

Paonias excaecatus Abbot and Smith. The Blind-eyed Sphinx.

The kinds of food-plants of *P. excaecatus* are even more numerous than those of the twin-spotted sphinx. The larvae, however, are most commonly found on wild cherry, oak, birch, willow, and poplar.

The species is widely distributed in the eastern United States and in eastern Canada.

P. excaecatus was common at Orono during this study. A single brood, in June and July, is definitely indicated from the captures at light-traps. Most of the specimens were secured late in June and during the first half of July. The total number of moths taken was 80. Only 3 females were found. Figure 9 shows the captures of this moth during each week of its period of flight.

Paonias myops Abbot and Smith. The Small-eyed Sphinx.

The larva feeds upon wild and cultivated cherry.

This moth is found from Canada to Florida and west to the Mississippi. Beutenmüller (1895, p. 315) reports that it is rare in the neighborhood of New York City.

P. myops was not as common during the 1931-1934 interval as *P. excaecatus*. Moths of both of these species were captured at lights during almost identical periods of time. All of the 36 individuals of *P. myops* were males.

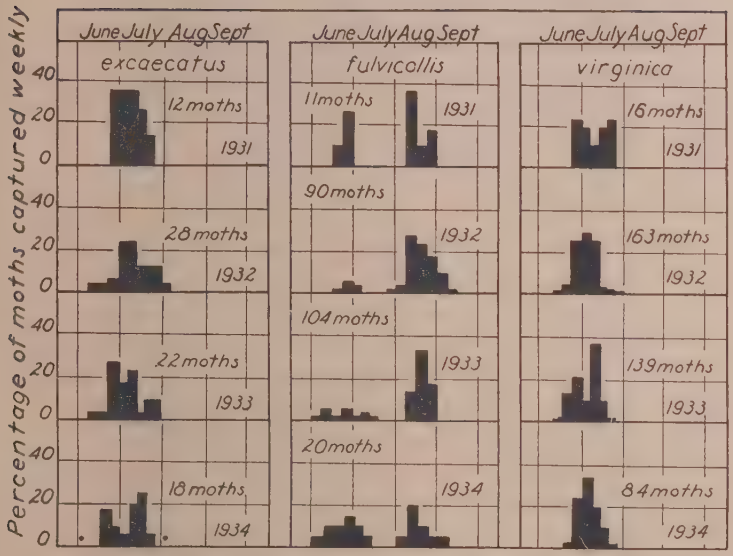

FIG. 9. A graphic summary of records of moths of the species *Paonias excaecatus* A. & S., *Scepsis fulvicollis* Hbn., and *Ctenucha virginica* Charp. captured at lights during a period of four years.

The June to early August period of flight for *P. excaecatus* is also typical of many other species of Sphingidae at Orono, Maine.

S. fulvicollis clearly gives evidence of two broods; with June and August peaks of activity.

C. virginica is in flight from June 12 to the end of July, with slight variation in time from year to year.

GENUS *Pachysphinx* ROTHSCHILD AND JORDAN

Pachysphinx modesta Harris. The Modest Sphinx.

During the larval stage this insect feeds upon willow and poplar.

P. modesta has a wide distribution in the United States, from the Atlantic to the Pacific, and it ranges northward in Canada and southward to Mexico.

This beautiful hawk-moth was captured, in comparatively large numbers, during 1932 and 1933. It was less common the other two years. The 25 moths secured during 1932 rather fully establish the time of flight as taking place in June and July. All captures, in the other years, came closely within the

time limits of 1932. When considering all years, *P. modesta* was on the wing and came to lights from early June until early August. A single brood is indicated by the records.

There were 18 females among the 52 specimens taken. All of the females except 4 contained eggs in their ovaries.

FAMILY SATURNIIDAE

The members of the family Saturniidae, known as the Giant Silkworm Moths, are species of large or very large size. The moths of no other group excel the Saturniidae in size. All native Lepidoptera of the group are striking and attractive in appearance.

Although 5 members of the Saturniids were represented in the captures during this study, only *Automeris io* was obtained in considerable numbers.

Specimens of *A. io* were secured each year and the captures of the four years totaled 29 moths. The period of activity for moths of this species came in June and early July.

During the study only a single moth of *Samia columbia* appeared. The specimen was captured early in June, 1932. The larva feeds upon larch.

Very limited numbers of *Samia cecropia, Tropaea luna,* and *Telea polyphemus* came to the light-traps. Dr. W. T. M. Forbes (1923, pp. 668-675) gives an excellent discussion of this family in his "Lepidoptera of New York and Neighboring States."

FAMILY CITHERONIIDAE

The moths of this family are closely related by structural characters to the Saturniidae. The name, royal-moths, is popularly applied. Only *Anisota rubicunda* is represented among the light-trap captures.

Anisota rubicunda Fabr. Green-striped Maple Worm.

The food-plants are maple and oak, according to Beutenmüller (1898, p. 441). Kotinsky (1921, p. 44) states that swamp or red maple and silver maple are favored as hosts, but other trees are fed on in the absence of these.

A. rubicunda is found from Canada to the Carolinas and westward to Kansas and Missouri.

Moths of the green-striped maple worm were obtained each year, but the insect was most common in 1932 when 23 individuals came to lights. The species has a period of activity during June, July, and early August. The moths are most numerous during the last two weeks of June and the first week of July and limitation to one generation seems apparent from our records. A single female was taken in the 4 years among the 42 moths.

In its southern range the green-striped maple worm may have two or three generations a year. (Kotinsky 1921, p. 45.)

Family Euchromiidae

Unlike most moths, the members of the Euchromiids are diurnal in their habits and also are attracted to lights. They are small, or only medium in size. During this study, two species belonging to the family Euchromiidae were taken. Both moths were very abundant. In numbers of species the family is limited; only 3 species are reported from New York State.

Genus *Scepsis* Walker

Scepsis fulvicollis Hbn. The Yellow-collared Scape Moth.

The larva feeds upon various grasses. It is most common in low, swampy meadows.

S. fulvicollis is found widely in North America, from Canada southward to the Gulf States and Mexico. Its westward distribution extends to the Rocky Mountains.

The moth has two broods at Orono. The period of flight for the first generation was observed, annually, in June and early July. (See Figure 9.) Moths of the second brood were taken in August every year and in straggling numbers in September for two years. Individuals of the second generation during 1931, 1932, and 1933 were more abundant than those of the first. During the 4 years a total of 225 specimens were secured, and among them was found but 1 female.

GENUS *Ctenucha* KIRBY

Ctenucha virginica Charp. The Virginian Ctenucha.

The caterpillars of this insect will accept a wide range of grasses, and also species of sedge and iris, according to Patch (1921, p. 313). Outbreaks are exceedingly rare. In 1920, however, the insect became very common in Maine and an estimated abundance of 4,000 larvae to the acre was reported by Patch (1921, p. 310).

The moth is found from Canada to Virginia and westward to the Mississippi. It is common in the northern portion of its range.

Large numbers of *C. virginica* were taken during three of the four years of the 1931-1934 interval. The moths came to lights during almost identical periods each year. The time of flight extended from mid-June until the end of July. (Figure 9.) With few exceptions all moths were captured between June 15 and July 20. Females were extremely uncommon at lights, as only 2 were found among the total captures of 402 moths.

The accuracy of observations at light-traps in determining the period of abundance of the moths is very high for this species. At least, it agrees closely with field observations reported by Patch (1921, p. 310). She found at Orono that the moths were present from late May to early August. They were most abundant, however, from the middle of June to the middle of July.

FAMILY ARCTIIDAE

The Arctiids are called tiger-moths, because the wings are frequently strikingly spotted or striped. As a group, the moths have stout bodies and wings which fold roof-like upon the abdomen. This is an important family among the Macrolepidoptera; its species are numerous and among them are a number of economic pests. The larvae are quite densely covered with long hairs. The larvae of some species are called "wooly bears" and others "tussock caterpillars."

The tiger-moths were captured abundantly during this study. Eighteen species and 2,403 individuals were taken. The period of flight for 10 species is reported in detail.

Genus *Halysidota* Hübner

Halysidota maculata Harris. The Oak Tussock Caterpillar.

The larva is reported by Houser (1918, p. 245) as occurring in greatest abundance on oaks. He considers that it is a wide feeder, and lists in addition the following food plants: sourwood, ironwood, hazel-nut, poison sumac, June-berry, wild plum, Judas tree, sugar maple, beech, poplar, willow, alder, hickory, and elm. The larvae feed singly. As a rule injury is not of a serious nature.

The moth has a distribution from Canada southward to Maryland and westward to California.

H. maculata was present at lights each year in medium numbers. During each of the two years (1932 and 1934) 31 moths were taken. A smaller number came to the traps in 1931 and 1933.

A period of activity from the middle of June to the middle of July is generally characteristic of this species. The heaviest flights occurred, each year, either during the last week of June or early in July.

Males were represented by 73 specimens and females by 29 specimens among the complete captures.. The eggs were in a well-developed condition among a majority of the 27 gravid females.

Halysidota tessellaris Abbot and Smith. The Pale Tussock Caterpillar.

The kinds of food plants of *H. tessellaris* are even more numerous than those of *H. maculata*. Beutenmüller (1888, p. 76) has recorded it as feeding upon thirty-one plants. In Ohio, Houser (1918, p. 246) has found that sycamore is more commonly attacked than any other tree or shrub.

This insect has a wide distribution in America from Canada to Central and South America. In the United States it is found westward to the Mississippi. Beutenmüller (1898, p. 370) reports it as very common in southern New York.

Few moths during this study were taken in greater numbers than *H. tessellaris*. Among all the tiger-moths, it was most common. Nearly 500 specimens came to lights during the two seasons of 1932 and 1933. The total captures exceeded 1,100 moths.

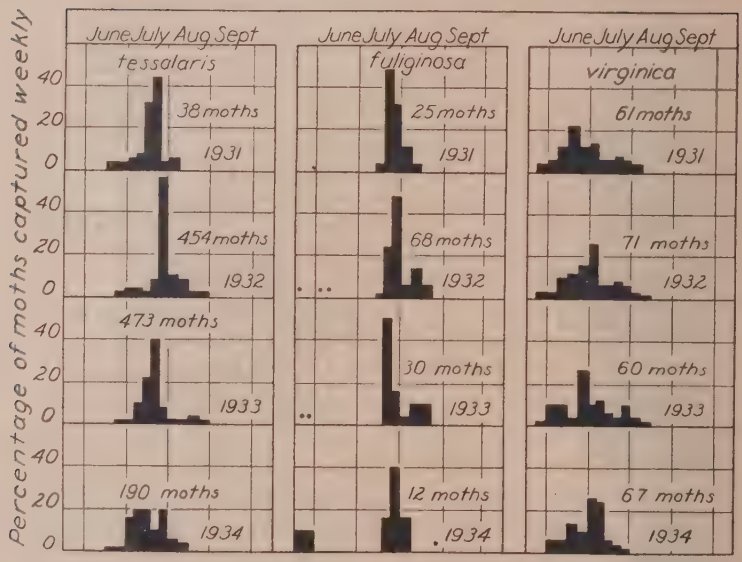

FIG. 10. A graphic summary of records of moths of the species *Halysidota tessalaris* Harris, *Phragmatobis fuliginosa* L. and *Diacrisia virginica* Fabr. captured at lights during a period of four years.

A climax toward the end of July, with straggling moths in late June and again in August, seems characteristic of *H. tessalaris.*

P. fuliginosa shows evidence of a small brood in May and early June and a full brood between mid-July and the end of August.

The flight of *D. virginica* is unusual for the uniform number of moths captured during each of the four years. An extended period of activity from early May to the middle of August with a maximum flight in late June or early July is evident.

H. tessellaris was secured most abundantly during July, although the period of flight began about June 15 and extended until the end of August during two years. The peak of activity was observed generally to come in the last half of July. (Figure 10.) The number of moths, which appeared in June ahead of the main flight and likewise those in August at the end of the flight, was small in comparison with the total captures. No outstanding differences in the time of activity were observed between the flight of one year and that of another. The extreme increase to 454 individuals in 1932 from 38 individuals in 1931 is of interest.

In *H. tessellaris* the proportion of males to females was nearly equal, in fact, 41 per cent of all moths captured were females. During the peak of abundance, the two sexes were noted to be approximately equal. For example, on the night of July 28, 1932, 74 males and 62 females were obtained. On a number of nights in 1932, a few more females than males came to lights. The same relationship was observed the following year. The largest catch of females and also total moths for any one night occurred on July 24, 1933. There were 94 females in the total captures of 146 moths for that date.

Of the females, 85 per cent contained eggs. On the whole the gravid moths secured early in the flight period showed eggs in an immature condition. In contrast, dissected females, captured at later dates, frequently disclosed eggs fully matured and ready for deposition. A number of the females captured at the end of the flight had deposited all or a portion of their eggs.

Genus *Phragmatobia* Stephens

Phragmatobia fuliginosa Linnaeus. The Ruby Tiger-moth.

The larva feeds upon a variety of herbaceous plants and is partial to golden rod (*Solidago*), Joe Pye weed (*Eupatorium*), and iron-weed (*Vernonia noveboracensis*).

The ruby tiger-moth is widely distributed throughout the cooler parts of Asia, Europe, and North America, according to Holland (1903, p. 126). In the United States the moth is common in New England and southward, at higher elevation, to the Carolinas. It is also found along the slopes of the Rocky Mountains.

P. fuliginosa apparently, under Maine conditions, has a partial brood in May and early June; and a full brood in mid-July to late August. (Figure 10.) Individuals of the first brood were few in number each year. In 1931, although 25 moths representing the later brood were taken, none of the first brood came to the light-traps. During the other three years, a few moths secured in either May or early June, gave evidence of this partial brood.

The moths of the main brood annually appeared at a date later than July 10. However, each year, the height of activity

came during the last two weeks of July. Reduced numbers of the insect were obtained until near the end of August.

Beutenmüller (1898, p. 374) reports that this species is double brooded along the Hudson in southern New York. Under New York conditions the broods were found to come in May and June, and again in August.

Only 7 females were found among the entire captures of 134 individuals of this Arctiid.

GENUS *Diacrisia* HÜBNER

Diacrisia virginica Fabricius. The Yellow Woolly-bear Caterpillar.

Ever since the writings of Harris in 1841 (1862, p. 349) on "Insects Injurious to Vegetation" this insect has been recognized as a troublesome pest in gardens. It is a wide feeder and attacks many species of flowers as well as the garden plants. Weigel and Middleton (1928, p. 14) state that the species is omnivorous.

The moth is common everywhere in its range throughout the United States.

This species was uniform in its abundance during the four years of this study. Between 60 and 70 specimens were captured each year. The total period of time the moths were on the wing and came to lights covered 12 weeks or from early May until the middle of August. The early appearing individuals and again those at the end of the flight were not numerous. A high percentage of the captures were made between the dates of June 12 and July 22. (Figure 10.) There is no evidence at Orono of more than one extended brood.

At Ithaca, New York, Forbes (1923, p. 152) reports that in 1922 two definite broods occurred, while during the other year of his investigation, the second brood was greatly reduced in numbers. The climax in number of moths of the respective broods came on June 6 and August 5.

The males far outnumbered the females of this species. In the complete captures 237 males and 21 females were found. Most of the females when taken contained a large number of eggs.

GENUS *Isia* WALKER

Isia isabella Abbot and Smith. The Black-tipped Woolly-bear Caterpillar.

The larva feeds upon a wide range of herbaceous plants. Holland (1903, p. 125) states that it is to be found particularly on the leaves of plantain (*Plantago*) and upon grasses. Although a common insect, it is not an economic pest of note.

This Arctiid is found in all sections of the United States.

The Isabella tiger-moth occurred in moderate numbers each year. The range in fluctuation of abundance varied from 22 moths in 1931 to 61 moths in 1932. The months of June

FIG. 11. A graphic summary of records of moths of the species *Isia isabella* A. & S., *Hyphantria textor* Harris, *H. cunea* Dru. and *Estigmene acreae* Dru., captured at lights during a period of four years.

The flight of *I. isabella* extends from early June to the end of July or early August with a period of maximum activity late in June or early in July.

H. textor and *H. cunea,* each has one generation at Orono. Moths on the wing during approximately the same periods as that of *I. isabella.*

E. acreae shows a striking decline in numbers between 1931 and 1934. A full brood prior to the middle of July and a partial brood in late August are evident.

and July covered the period of flight for the species. (Figure 11.) The height of activity was observed late in June or early in July. By the end of July the flight was over except for a few straggling individuals. That there is a single brood in Maine seems clearly evident. Beutenmüller (1899, p. 373) reports this insect as double-brooded farther south in New York. He found the moths of the first brood to appear in June and those of the second in August.

Only 11 females were taken among all of the 175 individuals of *H. isabella.*

GENUS *Hyphantria* HARRIS

Hyphantria textor Harris. Fall Web-worm.
Hyphantria cunea Dru. Fall Web-worm.

The two species of Hyphantria are discussed together because of similarities of habits and life histories. *H. textor,* with its unspotted white wings and white antennae, may be distinguished from the also immaculate white-winged forms of *H. cunea* because the latter have dark or black antennae, while typical specimens of *H. cunea* have numerous small, black spots on their wings. *H. textor,* sometimes known as the spotless fall web-worm, was not quite as abundant as *H. cunea.* The total number of captures of the latter species consisted of 101 individuals, and 64 of the former were taken.

The larvae of the fall web-worms are social in their habits and spin webs on the tips of the branches of the trees they attack. Deciduous trees of many species are fed upon by these insects. Felt (1905, p. 143) reports that 120 food plants have been listed for the fall web-worms. Frequently, apple foliage is injured on unsprayed trees.

H. cunea is found as a common species over the entire United States from southern New England to Texas and Montana. *H. textor* has a southern and western distribution similar to that of *H. cunea,* and in addition is found in Canada and northern New England.

Only 8 specimens of the two species were taken in 1931, but throughout the other years, the moths of both species were fairly common. During 1932, 1933, and 1934, the periods of flight were closely alike. No specimens were taken in May.

(Figure 11.) Generally, a few individuals appeared each year prior to the middle of June. By the end of June or early in July, the period of greatest activity at the lights was attained. The end of the flight was over before the last of July or by early August. In 1934, flight began and also closed a week or 10 days earlier than in the two previous years. Only one brood is evident for each of the species of the fall web-worms in Maine.

Of the 165 moths of *H. cunea* and *H. textor* all specimens except one were males.

In its range in New York, *H. cunea* is double brooded; while *H. textor* is normally one brooded, according to Forbes (1926, p. 667). Beutenmüller (1898, p. 876) states that the moths of the first generation of *H. cunea* appear in late April or early in May to June in the vicinity of New York City. He found the second brood to occur in July and August.

Genus *Estigmene* Hübner

Estigmene acraea Dru. The Salt Marsh Caterpillar.

The caterpillar of *E. acraea* received its common name from the observations of Harris (1862, p. 351) who noted it as a pest upon the swampy grassland of eastern Massachusetts. The salt-marsh caterpillar, however, is a wide feeder, and freely attacks garden vegetables, clovers, corn, cotton, and many other herbaceous plants, according to Forbes (1905, p. 74). Control measures are at times necessary to prevent its ravages.

This moth has a wide distribution in North America from Canada to Mexico. It is found throughout the length and breadth of the United States and is, perhaps, most common in the middle Atlantic States.

The fluctuating abundance of the individuals in a species is demonstrated when the numbers of yearly captures are compared for this insect. A marked decrease in abundance was observed during the period from 1931 to 1934. In 1931 the insect was common and 157 specimens came to the lights. During 1932, 44 moths were taken. During the last two years of this study, only 18 and 12 moths, respectively, were secured.

E. acraea was taken in greatest numbers at the end of June or very early in July. (Figure 11.) A well-developed first

brood was observed each year. The moths of this brood were on the wing from the last of May until July 15 to July 25. A second brood of greatly reduced numbers was found to be present. Less than 10 specimens of the second brood were taken during August in the two seasons of 1931 and 1932. No moths were captured in 1933 or 1934 to represent this late brood.

Forbes (1905, p. 74) in Illinois and Beutenmüller (1898, p. 373) in New York and others report the occurrence of two broods for this insect in regions having a longer growing season than Maine. Where the species is double-brooded, the moths of the first brood appear in May and June and those of the second in July and August.

Very few females were obtained among the moths of *E. acraea*. In the total captures were found 19 females and 212 males. The females that came to the traps were practically all gravid and had eggs well matured.

GENUS *Apantesis* WALKER

Apantesis virgo Linn.

Although three other members of this genus were taken during the four years of this study, *A. virgo* was the most common.

The larvae feed upon a wide variety of low growing vegetation, but are very seldom abundant enough to attract attention.

This insect occurs in Canada and southward in the United States to Virginia. Forbes (1926, p. 666) reports that it is found throughout New York.

A. virgo at Orono has a comparatively short period of flight, beginning near July 10 each year and ending about August 15. The height of activity was observed to take place during the last two or three weeks of July. Relatively few specimens were obtained in August. No outstanding variations in flight were noted between the different years. In New York, Forbes (op. cit.) found that the moths of *A. virgo* are on the wing during July and August.

GENUS *Arctia* SCHRANK

Arctia caja americana Harris. The American Tiger-moth.

The larva of the American Tiger-moth is a general feeder upon low growing plants.

The moth is found in Europe and North America. In the United States it has a northern distribution from the Atlantic to the Pacific. Beutenmüller (1898, p. 377) states that it is rare in southern New York.

The American tiger-moth was not taken in large numbers. A total of 31 specimens represents all the captures for three years. No representative of this species came to the lights in 1931, but in 1932, 1933, and 1934 small numbers of the moths were obtained.

This moth has a period of activity during the last of July and the first half of August. A short interval of three or four weeks covered the time in which captures were made each year.

The two sexes were represented in the total captures by 25 males and 8 females.

Family Noctuidae

No family of the Lepidoptera, in North America, exceeds the Noctuids in number of species. They are everywhere abundant and comprise the majority of the moths that are attracted to lights. During this study, 231 species or 68 per cent of all species were members of the family Noctuidae. This family also led in numbers of specimens taken, since among the 58,131 captures made, 24,038 or 43 per cent were noctuids.

Within the family, the moths differ greatly in size, in coloring and in form. The typical moth, however, is medium in size, and has a large body in proportion to the length of the wings. The colors of the fore-wings are nearly always sombre and generally of a different pattern than those of the hind-wings. The wing venation is closely similar throughout all groups of this family. Other well developed characters are: a frenulum, two ocelli, and prominent labial palpi.

The larvae are, in the majority of cases, naked, dull in color, and provided with five pairs of prolegs. Most of the larvae feed upon foliage and many are polyphagous upon low growing vegetation. Among the destructive species are found many cutworms and army worms.

GENUS *Heliothis* OCHSENHEIMER

Heliothis obsoleta Fabr. The Corn Ear Worm.

The larvae feed upon a wide range of food plants. They are notorious as pests on ears of growing corn, on green and ripe tomatoes, on pods of beans, and in the south on bolls of cotton. In many sections of the United States, the larvae of this species are among the most destructive pests of corn.

The corn ear worm is cosmopolitan or almost world wide in its distribution. The insect is common throughout the United States and southern Canada.

During the four years of this study a total of 15 moths of *H. obsoleta* were secured. The fact that the moths were captured only in September and early October is suggestive of one brood in Maine. However, the numbers taken were too small to fully determine its seasonal occurrence.

Reports of injury by the corn ear worm are of infrequent occurrence in Maine, substantiating the light-trap captures as the evidence of one brood. Phillips and King (1923, p. 10) give the number of annual generations as varying from one in the extreme north to as many as seven in the southern part of the United States.

GENUS *Euxoa* HÜBNER

Eleven species of moths in the genus Euxoa were taken in the period of 1931 to 1934. The moths of this genus were captured at such periods as to indicate that none has two broods annually in Maine. In 1933 and 1934 the Euxoas were noticeably more abundant than in the previous two years.

All members of the genus Euxoa are considered to be cutworms, according to Forbes (1926, p. 662). *E. messoria* and *E. tessellata* rank among the very destructive cutworms of the United States.

Euxoa messoria Harr. The Dark-sided Cutworm.

An extensive list of food plants for the dark-sided cutworm is given by Crumb (1929, p. 90). Although it feeds widely upon garden and field crops, the climbing habit is unusually well developed. It is often destructively injurious to the new growth of orchard trees and flowering shrubs.

In distribution this moth ranges from Canada southward to the latitude of Tennessee and westward to California.

A total number of 28 moths of *E. messoria* were captured at lights during 1933 and 1934. The captures were made between August 16 and September 11. In the eastern Provinces of Canada, the moths of *E. messoria* are on the wing in August and September and even as late as October 5, according to Gibson (1915a, p. 20). According to the observations of the writer, *E. messoria, E. vellerpennis, E. fumalis, E. decolor,* and *E. obeliscoides,* all have similar periods of adult activity during August and September.

Euxoa tessellata Harris. The Striped Cutworm.

The larva of *E. tessellata* has been recorded by Forbes (1905, p. 34) and Crumb (1929, p. 94) as having a wide range of host plants. It is particularly a pest of vegetables, attacking cabbage, celery, lettuce, potato, tomato, cucumber, melon, onion, beet, and carrot. In addition, the climbing habit results in its feeding upon the buds and newer growth of apple, peach, grape, and various shrubs.

E. tessellata extends its range from Canada throughout the United States north of Virginia and the Ohio River. In the West it also occurs in the southern Rocky Mountains.

The period of abundance was from the middle of July until early August. In comparison with *E. messoria* the main flight of *E. tessellata* was about one month earlier, although straggling moths occurred until early September. Gibson (1915b, p. 29) states that in Canada the moths were collected commonly in July and in smaller numbers in August.

In all, 42 moths were captured during the four-year observation period; however, only in 1933 and 1934 were the moths common at lights. Twelve gravid females were noted among the moths secured.

Genus *Feltia* Walker

All species of Feltia are cutworms, according to Forbes (1926, p. 662). A total of six species in this genus were captured at lights, namely: *F. gladiaria, F. venerabilis, F. ducens, F. subgothica, F. herilis,* and *F. volubilis.* The light-trap records suggest that all of these species are single-brooded in

Maine. *F. volubilis* was the least abundant of the five species and captures of it were made only in 1934. Representatives of the other species were obtained during each of the four years. In 1933 and 1934 heavy flights of *F. venerabilis, F. herilis,* and *F. ducens* were observed. With the exception of *F. volubilis,* which has its main flight in May and June, the moths of the other 5 species are abundant only at some period after the middle of July.

Feltia gladiaria Morr. The Clay-backed Cutworm.

This cutworm is known to feed upon tobacco, clover, corn, cabbage, aster, goldenrod, pansy, oats, grass, potato, bean, sweet potato, tomato, onion, blackberry, raspberry, hemp, and strawberry, according to Crumb (1929, p. 68). It is particularly injurious to corn and clover.

The range of this moth includes all of the United States east of the Rocky Mountains and the southeastern part of Canada.

A total of 59 moths of *F. gladiaria* were captured in the four-year period. The flight period extended from August 22 to September 25. The main flight occurred during the first two weeks of September. Only 4 gravid females were found among the total number of moths. Slingerland (1902, p. 211) reports that the main flight occurs early in September at Ithaca, New York.

Feltia venerabilis Wlk. The Dusky Cutworm.

The food plants of this species are not well known. Crumb (1929, p. 74) reports that it has been reared upon clover and chickweed, and that it is injurious to plants in vegetable gardens and also to oats.

The moths of *F. venerabilis* occur in Canada and the northern half of the United States from the Atlantic States to the Pacific. Its southern range extends to Virginia, Tennessee, Texas, and California.

F. venerabilis was the most abundant of the species of Feltia. During the study, 94 moths were captured in 1931, 69 in 1932, 330 in 1933, and 282 in 1934, making a total of 775 moths for the entire period. The moths came to lights in largest numbers during the period of September 7 to September 21. The full period of flight extended from the last week of

August to October 1. (Figure 12.) Among the total captures 56 females were secured, of which 52 were fully gravid. The eggs of the gravid females were found to be generally in a well developed condition.

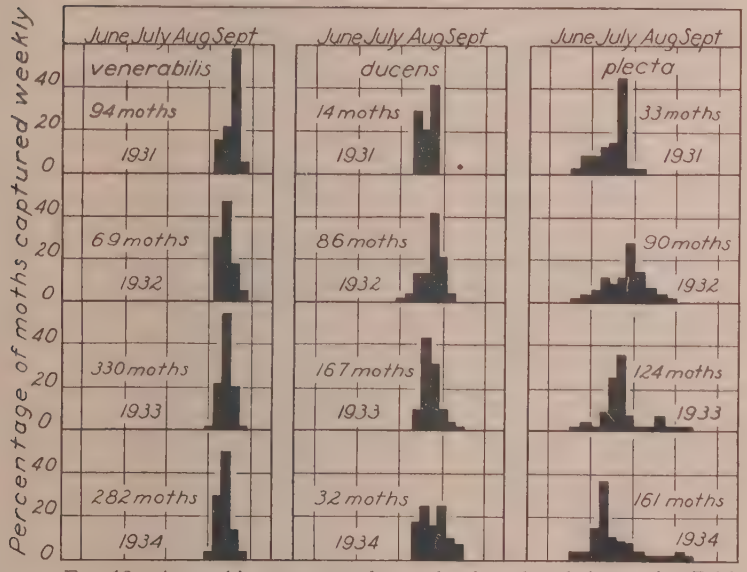

Fig. 12. A graphic summary of records of moths of the species *Feltia venerabilis* Wlk., *Feltia ducens* Wlk., and *Agrotis plecta* L., captured at lights during a period of four years.

The flight of *F. venerabilis* is almost entirely within the month of September and with only a slight variation in time of the peak from year to year.

The moths of *F. ducens* first appear at the end of July or in early August. The main flight came between August 14 and September 4 and activity ceased by the middle of September.

A. plecta each year had a well defined peak of flight in July although moths during the four year study were taken as early as June 13 and as late as September 11.

Feltia ducens Wlk. The Dingy Cutworm.

In addition to being a general feeder upon many vegetables and field crops, the dingy cutworm sometimes climbs shrubs and trees and feeds upon the tender buds. In Maine it has been recorded by Phipps (1930, p. 150) as attacking swelling buds of blueberries.

F. ducens is widely distributed in the United States and Canada. It is most abundant in the northern part of its range.

Under the term "dingy cutworm" are included several species or forms whose limits and number vary according to whatever authority is adopted. Based upon studies of the moths, three species are generally considered to make up this group, namely, *F. ducens, F. subgothica,* and *F. herilis.* The cutworm larvae, however, of the species involved cannot be clearly distinguished from each other.

The food plants, as well as the early life stages and habits of these species, are practically identical.

In 1933 a heavy flight (157 moths) of *F. ducens* was captured. A total of 299 moths were taken during the 1931-1934 period. This insect was low in numbers in 1931 and again in 1934. (Figure 12.) The flight of the moths began at the end of July and extended to the middle of September. During the two years in which heavy flights were observed, 1932 and 1933, the moths were captured in large numbers only during the period from August 14 to September 4. In fact, 93 per cent of all specimens were secured between these dates. Crumb (1929, p. 61), in reviewing the life history of *F. ducens* as observed by investigators in Iowa, Illinois, New York, and Canada, states that the principal flight occurs between August 15 and September 5.

Among the captures were 34 females. All of them were gravid.

Feltia subgothica Haw. (*tricosa* Lint.). Dingy Cutworm.

The flight of this species extended over an interval of 9 weeks, beginning July 24 and ending September 18. The main flight began the last week of July and continued through the month of August. In 1934, 38 moths were secured at Orono, 70 per cent of them being taken between July 24 and August 21. Forbes (1923b, p. 153) states that the principal flight at Ithaca, New York, in 1922 was in July although a flight of less proportions occurred in August. His observations were based upon 15 moths captured at light traps.

A total of 63 moths of *F. subgothica* were captured. Among them were 20 females, 18 of which were fully gravid.

Feltia herilis Grt. Dingy Cutworm.

This insect was slightly more abundant than *F. ducens* dur-

ing the period of 1931-1934, as a total of 302 moths were obtained. In 1933 and again in 1934 the species was common. The principal flight occurred in August while scattering moths were observed in July as well as early in September. The complete period of flight extended from July 8 to September 11. The moths of *F. herilis* appeared during late July and early August in greater number than the moths of *F. ducens;* in other respects the flight period of the two species is very similar.

Only 28 females, all gravid, were observed among the captures.

Genus *Agrotis* Ochsenheimer

A total of 14 different species of moths within the genus Agrotis were recorded. Many authorities now place a number of these species in the genus Noctua. In the group are a number of very important cutworms. In Maine, Phipps (1930, pp. 151-152) has found that *A. c-nigrum, A. bicarnea, A. normaniana, A. phyllophora, A. fennica,* and *A. claudestina* are among the cutworms that attack blueberries. The black-lined cutworm, *Agrotis fennica,* is particularly an important blueberry insect at rather infrequent intervals, causing serious losses when outbreaks occur.

Agrotis ypsilon Rott. The Greasy Cutworm.

The greasy cutworm is a cosmopolitan insect, occurring in injurious numbers throughout the world. It is widespread in the United States and Canada, and, while usually abundant, often is not as destructive as certain other cutworms. It is a general feeder but does not show a well-developed climbing habit.

The moths of *A. ypsilon* came continuously to lights from the last week in May until early October. A graph (Figure 13) of the seasonal distribution during each year, 1931-1934, does not show clearly the number of broods. In 1932, however, when 118 moths were caught, a light brood in June and a heavy brood in August was definitely indicated. Two broods about equal in numbers were apparent in 1933 when 73 moths were captured at lights. Lintner, in studying this insect under New York conditions (1893, pp. 188-181), states that moths were taken on every night during the season, beginning May

30 and ending in September. Scattered moths continued to fly until the last week in October. Gibson (1915b, pp. 16-17) states that the number of broods is not definitely known but that two possibly occur in southern Canada. Crumb (1929, p. 33) reports that *A. ypsilon* is four-brooded in Tennessee.

Among the total catch of 288 moths were 71 females. Of the females, 76 per cent were fully gravid. The degree of development of the eggs in the ovaries of the gravid females varied widely. The eggs of a number of the moths were in the early stages of development, in other cases the eggs were about half developed, while the eggs were almost completely matured in a majority of the moths.

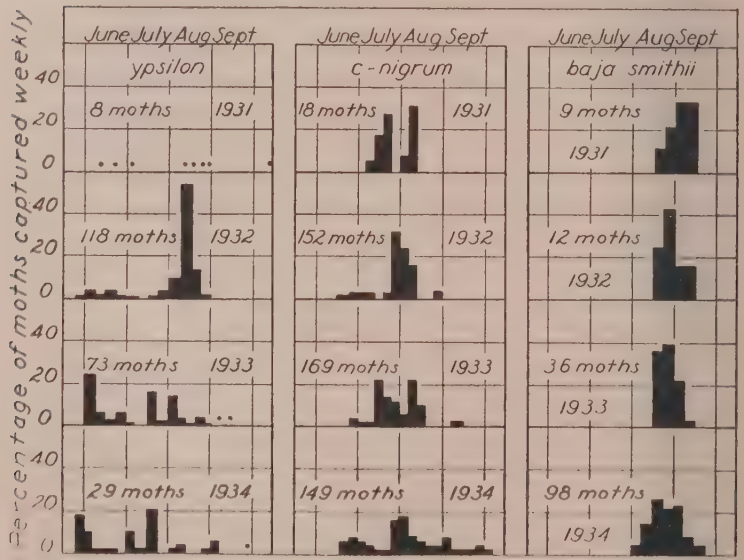

FIG. 13. A graphic summary of records of moths of the species *Agrotis ypsilon* Rott., *Agrotis c-nigrum* L., and *Agrotis baja smithii* Snell captured at lights during a period of four years.

A. ypsilon apparently has two broods at Orono. The graph for 1932 shows this most clearly with a peak of moth activity in June and again in August.

A. c-nigrum shows an extended flight of one brood from the middle of June until September or early October.

A. baja smithii gradually increased in abundance from 1931 to 1934. The species has a flight in August and September with a climax toward the end of August or in early September.

Agrotis c-nigrum L. The Spotted Cutworm.

This cutworm has a wide range of food plants. It has been reported by Crumb (1932, p. 88) as feeding upon the tips and buds of cranberries, blueberries, and other shrubs. In years of great abundance, it may feed during daylight hours and assume the army worm habit.

This insect occurs in Canada and in the northeastern part of the United States. The species is scarce or absent south of Virginia, Tennessee, and Kansas, according to Crumb (op. cit.).

A. c-nigrum was the most abundant moth of the Agrotis group during the four years of this study. With the exception of 1931 the moths were very abundant each year, as a total of 488 specimens was recorded. The first moths of the season were secured the middle of June, and from that time until early October flights appeared each week. (Figure 13.) Heavy flights took place only during a six-weeks period from July 17 to August 21. Over 70 per cent of the moths were secured between these dates. In contrast with *A. ypsilon,* while moths occurred the last of May, no flight of *A. c-nigrum* was recorded until after June 12. Also, as only very few moths appeared in September, it is evident that only one extended brood occurs in Maine, unless the straggling flight in September and early October represents a partial second brood.

Forbes (1923, p. 153) from light-trap studies at Ithaca, New York, considers *A. c-nigrum* as having two broods, the first brood flying in early July and the second in August and September. Although this is one of the common cutworms, no detailed investigation of its life history has been made. The work of S. A. Forbes (1905, p. 25) in Illinois, and that of Gibson (1915b, pp. 23-24) in Canada indicate the presence of a second generation.

Of the moths captured at lights, 25 per cent were females. The gravid females composed 74 per cent of the total number of that sex. The percentage of females and the percentage of gravid females for *A. c-nigrum* was practically the same as for *A. ypsilon.*

Agrotis bicarnea Gn. A Cutworm.

The food plants of this relatively unimportant cutworm are reported by Phipps (1930, p. 151) to include blueberry, gray birch, dandelion, maple, and meadow sweet.

This species is found from Canada to Colorado.

The flights of *A. bicarnea*, as determined by captures at lights, occurred between July 20 and September 5. The climax of flight took place about August 15. Limitation to one brood is clearly indicated from the data. Only one generation is also the report of Forbes (1923b, p. 153) for the species in New York.

Total moths captured were 69, females 15, and gravid females 13.

Agrotis baja smithii Snell. A Cutworm.

This relatively unimportant cutworm is a rather general feeder on low-growing plants.

The moths have been taken in New York and New England. They also are found in Canada.

The period of flight for the one brood of moths extends from August 1 to September 18. The last two weeks of August and the first week of September covered the time of greatest abundance according to the light-trap captures. (Figure 13.)

The entire number of moths captured during the four-year period totaled 155, including 19 females, of which 18 were gravid.

Agrotis plecta L. A Cutworm.

This species occurs over an extensive territory in North America from Canada to Texas.

Moths to the total of 408 of this unimportant cutworm were captured during 1931-1934. The one brood has an extended period of flight, beginning at the middle of June and ending in early September. However, heavy flights occurred only during the last three weeks of July. (Figure 12.) The climax of activity came July 19 in 1931, July 29 in 1932, July 23 in 1933, and July 8 in 1934.

The females of *A. plecta* were not as abundant as the males at the lights. Only 95 females were recorded among the total moths. With the exception of 10 individuals, all of the females proved to be gravid.

GENUS *Lycophotia* HÜBNER

Representatives of four different species of Lycophotia were obtained in considerable numbers during this study. *L.*

occulta, L. margaritosa, and *L. lubricans* were taken each year. *L. astrica,* the least abundant insect of the group, was not secured in 1931, but was recorded in 1932, 1933, and 1934. All species in this genus are cutworms, but *L. lubricans* apparently has not been recorded as an economic pest.

Lycophotia occulta L. A Cutworm.

This insect is distinctly northern in its distribution. In the United States it occurs from New England to Colorado. In addition, it is found in Canada, in Greenland, and in northern Europe and Asia. In Maine, Phipps (1930, p. 166) reports it as feeding upon blueberry and maple. There does not appear to be any other economic record in North America.

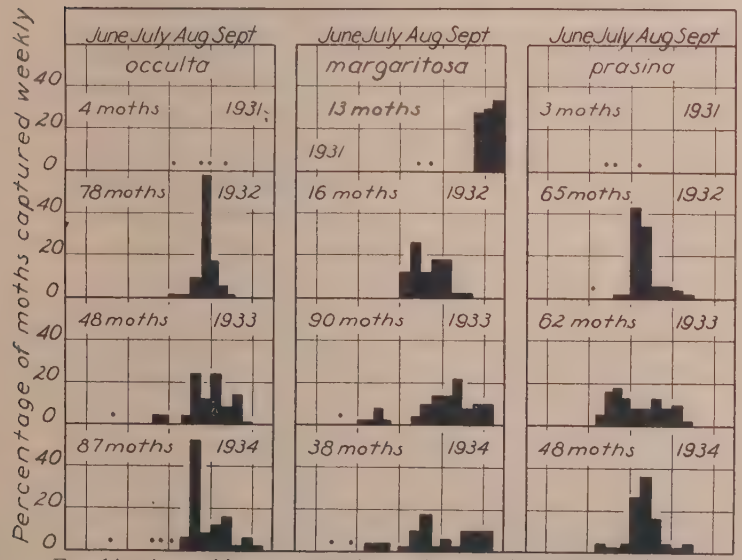

FIG. 14. A graphic summary of records of moths of the species *Lycophotia occulta* L., *Lycophotia margaritosa* Haw., and *Matuta prasina* Fabr. captured at lights during a period of four years.

L. occulta has a well-defined brood in August and September and apparently a brood of relatively few moths in June and July.

L. margaritosa has two broods at Orono. The chart for 1933 shows this most clearly. The first generation moths come in June and July and the moths of the second generation are on the wing from August to October.

The flight of *M. prasina* is also typical of that of *M. youngi.* Both species appear about July 15 and are on the wing until near the end of September. The climax of adult activity comes in August.

L. occulta was common in 1932 and 1934 when 78 and 87 moths, respectively, were taken at lights. Specimens were obtained in largest numbers during August and September. Each year the height of abundance occurred after the middle of August and prior to September 15. In 1933 and again in 1934, a few scattered moths were captured in June and July. These moths are suggestive of a greatly reduced, early first brood. The occurrence of these early moths suggests that two generations may possibly occur in Maine. (Figure 14.) The complete captures consisted of 182 males and 35 females. All except two of the females were gravid.

Lycophotia margaritosa Haw. The Variegated Cutworm.

No cutworm in the United States is considered to be more destructive than the variegated cutworm. The reported food plants as listed by Crumb (1929, pp. 107-108) number more than 60. *L. margaritosa* is one of the most common cutworms in gardens and also in greenhouses. At irregular intervals great outbreaks occur in the United States, as in 1900, when damage to the extent of several million dollars was recorded (Chittenden, 1902b, pp. 91-92). The range of this almost cosmopolitan insect includes the entire North American continent as well as many other parts of the world.

Moths were captured each of the four years from 1931 to 1934, as shown in Figure 14. The seasonal distribution of the adult insect is perhaps most clearly indicated by the data secured in 1933 when 90 moths were captured. During that year more moths were recorded than in the other three years combined, although a small number (13 to 38) were captured each year. For 1933, the data suggest two broods; a reduced, early brood beginning in late June and extending through July, and a second, full brood beginning August 8 and continuing until September or early October. In 1934, 8 moths captured in June and July apparently represent the early brood, while 30 moths captured in August, September, and October represent the full second brood. During 1931 and 1932, when 13 and 16 moths respectively were recorded, no captures were made prior to August 5. Phipps (1930, p. 165) from rearing records in Maine, considers *L. margaritosa* to have two generations, stating: "the moths appearing in June and early July and again in late September." Also, Gibson (1915b, p. 20)

considers that two broods occur in Canada, the first brood represented by moths in June and the second brood by moths about the middle of August. In southern sections, 4 broods are reported by Crumb (1929, p. 109) for Tennessee. Among the 157 moths captured 32 were females. The 23 gravid females examined showed different stages of development of the eggs from immature to fully developed.

Lycophotia lubricans Gn. A Cutworm.

This insect is apparently without an economic record in the United States. A number of different forms of the moth are known. The species with its variations occurs throughout the length and breadth of the United States.

Similarly to *L. margaritosa,* this species was taken in greatest numbers in 1933. *L. lubricans* was most abundant during August, and the climax of flight took place during that month in 1932, 1933, and 1934. In 1931, only 3 scattered moths were obtained. The significance of 4 moths secured early in the season in late June and early July in 1934, and one moth in late June in 1931 is not clear.

A total of 131 specimens was taken, of which 14 were females.

Genus *Matuta* Grote

This is another genus all species of which are cutworms, according to Forbes (1928, p. 659). None of the species have important economic records. Representatives of *M. climata, M. youngi,* and *M. prasina* were captured during each of the four years of this study. In 1932, each of these species was more abundant than at any other time during the 1931 to 1934 interval. *M. climata* Gn. was the least common of the 3 species, a total of 23 individuals being captured during the four years.

Matuta youngi Sm. A Cutworm.

The distribution of *M. youngi* is confined to the northeastern part of the United States and to eastern Canada.

A total of 60 moths represents the captures for this species. *M. youngi* has one brood during the season. Flight of the moths began after July 20 and extended to about October 1. The majority of the specimens were captured in August. Females to the number of 20 were taken among the total captures. Of these females 15 were fully gravid.

Matuta prasina Fabr. A Cutworm.

The moths of *M. prasina* have been recorded in Canada, Massachusetts, New York, Iowa, and Colorado.

This economically unimportant cutworm was secured in moderate numbers during 1932, 1933, and 1934. The total captures comprised 178 moths. *M. prasina*, like *M. youngi*, has one brood during the summer. The flight of the moths extended from the second week of July to the middle of September, according to the studies of the writer. (Figure 14.) During two of the years, 1932 and 1934, the height of activity at lights occurred in August, while the July and September moths were obtained in relatively small numbers. In 1933, the heaviest flights were observed on July 17 and 19. However, specimens were captured, that year, all through the month of August and until September 6.

The 38 females captured comprised but 21 per cent of all moths secured. Twenty-one of the females were gravid.

GENUS *Scotogramma* SMITH

Scotogramma trifolii Rott. The Clover Cutworm.

The clover cutworm has proved to be more destructive in Canada than in the United States. The crops upon which it has inflicted damage are clover, peas, mangels, turnips, cabbage, lettuce, spinach, beets, and other vegetables (Gibson, 1915b, p. 26).

S. trifolii has a wide distribution in the northern hemisphere, and is reported from temperate regions in the southern hemisphere.

No large numbers of *S. trifolii* were observed during this study. In the interval, 1931 to 1934, 47 moths were captured. Activity at lights was observed to take place during two well-defined periods, indicating two broods. The first brood of moths was noted to extend through June to early July, and the second brood, through August to early September. In 1932, the only moths, 4 in number, were secured during August, and the first brood did not appear. During the other three years, both broods occurred each year. Gibson (op. cit.) reports that, in Ontario and the eastern provinces of Canada, moths of this species were

collected from late in May until autumn. He considers that it is at least double-brooded.

Ten fully gravid females appeared among the total captures of 47 moths.

Genus *Polia* Ochsenheimer

An even score of noctuid species in the genus Polia were captured at lights during this study. This is an unexpectedly high number of representatives of the genus, inasmuch as only 28 species are reported by Forbes (1926, pp. 657-658) in New York where the Family Noctuidae has been thoroughly studied over a number of years. Certain species were exceptionally numerous at lights, particularly during years of 1933 and 1934.

Apparently a number of the species were increasing in abundance, or weather conditions were unusually favorable for the development of large numbers of individuals in 1934.

TABLE 1

Comparison of Abundance of 11 Species of Polia for the Years from 1931 to 1934

Species	Number of individuals captured				Year of Greatest Abundance
	1931	1932	1933	1934	
POLIA IMBRIFERA	0	2	1	43	1934
POLIA PURPURISSATA	17	50	125	33	1933
POLIA SUBJUNCTA	6	19	65	99	1934
POLIA ADJUNCTA	0	0	17	29	1934
POLIA ATLANTICA	55	24	40	115	1934
POLIA LEGITIMA	14	57	92	226	1934
POLIA LILACINA	1	30	33	164	1934
POLIA ASSIMILIS	6	19	21	53	1934
POLIA RENIGERA	37	98	212	149	1933
POLIA LOREA	21	56	25	36	1932
POLIA OLIVACEA	1	32	98	62	1933
Totals	148	387	724	1009	

A decided increase in total numbers of moths for the 11 species from 1931 to 1934 is evident from the above table. Many of the other species of *Polia* show this same increase of moths from year to year during this time. Only one species, *P. lorea*, was more abundant in 1932 than at any other time. Three species, namely, *P. purpurissata*, *P. renigera* and *P. olivacea*, were most abundant in 1933. All of the other species in the

above list were taken in greatest numbers during the season of 1934.

The larvae of the moths in the genus Polia are feeders upon a wide range of common herbs. Included in the genus are a few destructive cutworms.

In every instance where a sufficient number of moths was captured to determine the periods of flight, every species of this group of noctuids was found to be single-brooded.

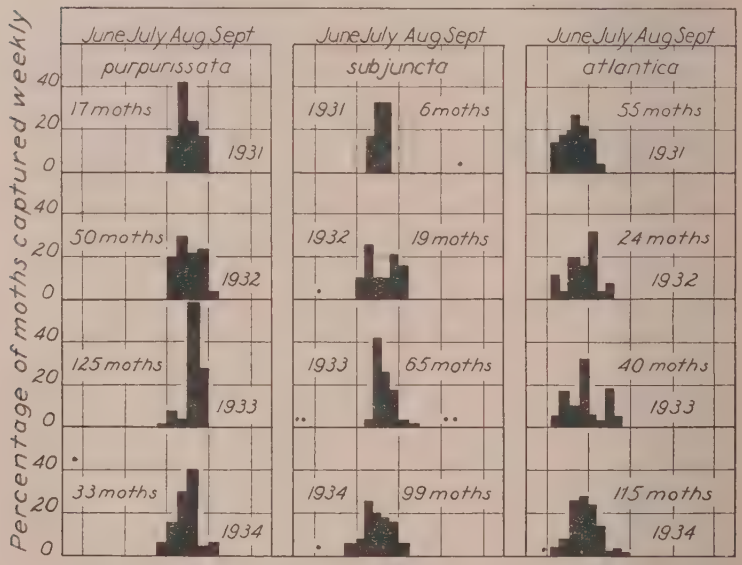

FIG. 15. A graphic summary of records of moths of the species *Polia purpurissata* Grt., *Polia subjuncta* G. & R. and *Polia atlantica* Grt. captured at lights during a period of four years.

P. purpurissata has a single brood with adult flight confined to August except for a few early and a few late individuals.

The flight of *P. subjuncta* comes in July with straggling moths preceding and also following the main flight. The species increased greatly in abundance from 1931 to 1934.

P. atlantica has an adult flight during June and July with a period of maximum activity in late June or early July. The chart for 1934 with 115 moths definitely indicates that there is only one brood.

Polia purpurissata Grt. The Blueberry Cutworm.

In Maine *P. purpurissata* is one of the most voracious and destructive of the blueberry cutworms, according to Phipps

(1930, p. 171). In addition, he reports it feeding upon a number of shrubs and herbs of common occurrence in blueberry fields. However, this insect does not have an important economic record outside of the state of Maine. It is generally distributed in eastern Canada, New England, and New York, as well as westward to Utah and British Columbia.

The moths of *P. purpurissata* are active in flight and attracted to lights during August. (Figure 15.) All captures out of a total of 225 individuals were taken in August except 3 moths in late July and 4 moths in early September. The climax of flight in all four years came between August 16 and August 24. A total of 41 gravid females were recorded among the complete captures. The eggs in the ovaries of most of the females were well developed and apparently ready for deposition.

Polia subjuncta Grt. The Speckled Cutworm.

The speckled cutworm is a relatively unimportant cutworm, although it was observed as early as 1869 by Riley (1869, p. 84) as one of the climbing cutworms. It has been recorded as feeding upon cabbage, upon the buds of fruit-trees, and recently by Phipps (1930, p. 173) as injuring the ripe fruit and foliage of the blueberry. Phipps reports that it feeds in the daytime and that in appearance it does not resemble a cutworm.

The moths have a distribution throughout Canada, the northern United States, and southward to New Mexico.

P. subjuncta is a common insect at Orono. A total of 189 moths were secured in the four-year period. The climax of flight was observed to take place in July during each year. (Figure 15.) A few straggling moths, however, precede and also follow the main flight. A summary for the entire period shows 2 moths captured in May, 7 in June, 166 in July, 11 in August, and 3 in September. Limitation to one brood is indicated by the seasonal distribution of flight.

A total of 40 females were observed among the total captures. All of the females were gravid except 4. The development of eggs in the ovaries varied widely, some moths showed an immature condition; in others the eggs were completely developed.

Polia atlantica Grt.

This insect does not have a record of being destructive to

crops to an important degree. However, it is known to be a wide feeder on herbaceous plants. The moths have been taken in Canada and in the United States throughout the area from Maine to Virginia.

P. altantica was the third most common of the *Polia* species in the course of this study. A total of 234 moths were captured. Figure 15 gives the seasonal distribution of the species and indicates one brood of moths during the summer. The activity of the moths began each year at the end of May or early June and became more pronounced until it reached a height toward the end of June or the beginning of July. After the peak of flight the species decreased in abundance over a period of three to four weeks. With very few exceptions all the moths were taken between the dates of June 1 and July 20.

The females of *P. atlantica* were not numerous, as only 26 were recorded in the four years. The eggs were, with few exceptions, in a developed condition ready for deposition among the 22 gravid females captured.

Polia legitima Grt. The Striped Garden Caterpillar.

The striped garden caterpillar has not developed the cutting habit prevalent among cutworms. It feeds and rests exposed above ground on its food plants. Chittenden (1907, pp. 28-32) and Crumb (1929, p. 116) report a list of plants upon which it feeds comparable to that of many cutworms but state that the injury done by this species is of minor importance. The probable normal food of the larvae is grass but in addition it has a rather broad range of hosts.

P. legitima occurs throughout Canada and the United States from Maine to Oregon and southward to Virginia and Kansas.

A total of 419 individual moths were obtained between 1931 and 1934. The insect frequented lights from about the first week in June until the first week of August. The largest number of captures were secured between July 8 and July 17, indicating a climax during that period. (Figure 16.)

Wherever this species has been studied, its life cycle shows a single brood. Crumb (1929, p. 116) states that it passes the winter in the pupal stage and that, under Tennessee conditions, "the pupae, after lying in the ground for nine months or more, begin to produce moths about the first of August. . . .and moths

are found on the wing until the middle of September." Apparently, under the cooler conditions and shorter season of Maine, the moths of this species emerge at least a month earlier than they do farther south. Also, the same factors seemingly cause *P. atlantica* to have a flight period earlier in Maine than in New York. Forbes (1926, p. 657) reports its flight period as July and August in New York, while the writer has shown that it occurs in June and July in Maine.

Relatively few females of *P. legitima* were secured; only 47 occurred among the total captures. Of the females 45 had a large number of eggs in their ovaries and were recorded as fully gravid.

Fig. 16. A graphic summary of records of moths of the species *Polia legitima* Grt., *Polia renigera* Steph., and *Nephelodes minians* Gn. captured at lights during a period of four years.

P. legitima increased greatly in abundance from 1931 to 1934. The climax of flight of the species comes in July.

The flight of *P. renigera* takes place in July and August, with the maximum moth activity during the latter month.

N. minians was especially abundant during 1933 and 1934. The flight of this species covers a five or six weeks period which begins about the middle of August and continues until near the end of September.

Polia lilacina Harv.

No economic records indicate that this insect is destructive. Its food plants have not been studied. The moths of *P. lilacina* have been taken in Canada and in the United States from New England westward to Colorado.

A total of 228 moths were secured during the course of this study. They were particularly abundant in 1934 when 164 captures were made. The period of flight at Orono for *P. lilacina* is similar to that of *P. legitima*. Very little difference was apparent in the time of flight for these two species in 1934 when both insects were more abundant than at any other time.

Only 10 females were observed among the total number of moths.

Polia assimilis Morr.

The food plants of *P. assimilis* are brake and other low plants. The species does not have an economic record. The range of *P. assimilis* is in the North, in New York, and other eastern states and in Canada.

A total of 99 moths was captured at lights during the four years. Flight began about June 15 and extended through July. The height of captures occurred either at the end of June or else during the first two weeks of July. Only 7 females were recorded.

Polia renigera Steph. The Bristly Cutworm.

The known food plants of the bristly cutworm include many herbs and grasses common to pastures and old clover fields. Such situations are particularly attractive to the species. The cultivated food plants are alfalfa, clover, cabbage, corn, grasses, tobacco, turnip, and garden flowers.

The range of *P. renigera* takes in most of the United States from Colorado and New Mexico eastward to the Atlantic Ocean. It is also distributed in Canada and Europe.

Only a few less than 500 moths of the bristly cutworm were captured during the years 1931 to 1934; it was the most abundant species of *Polia*. The flight at lights coincided almost exclusively with the two months of July and August. (Figure 16.) Moths were secured in small numbers in late June and again a few specimens were taken at the end of the flight period, during early September. The peak of activity was observed to occur regularly in August.

Crumb (1929, p. 23) reports *P. renigera* as two-brooded in Tennessee. Under his conditions, moths of the first brood appeared from the last of April until the middle or end of June, and the second brood of moths were in flight from early in August until early in October. The two periods of moth activity in Tennessee for this species as reported by Crumb are at wide variance to observations of the writer in Maine which demonstrate clearly but one brood.

Forbes in Illinois (1905, p. 35) and Garman in Kentucky (1895, p. 100) observed two broods, while Norman (1875, pp. 3-6) in Ontario states that the moths were very common from June 23 to October 9. Also, Forbes in New York (1923, p. 153) reports that flight is irregular, from May to October.

Among 496 moths captured of this species only 53 were females. All of the females were gravid, with the exception of one individual. Examination disclosed the fact that about half of the females contained eggs and that many of these had already deposited a portion of their eggs. In such moths, the eggs were relatively few in abundance and fully matured. Other females presented the appearance of being fully gravid and with many eggs in a stage ready for oviposition.

Polia lorea Gn. A Cutworm.

P. lorea does not have an important economic record. It feeds widely upon grasses and herbs. Phipps (1930, p. 170) reports its being collected in blueberry fields, but states that it apparently prefers sweet fern (*Myrica asplenifolia*) and spiraea (*Spiraea latifolia*) to blueberry.

The moth is found from Maine to Colorado in the United States and occurs in Canada.

A few more than 100 specimens of *P. lorea* were captured during the 1931-1934 interval. In 1932, when 54 moths were taken, the species was most abundant. During 1932, captures at lights extended over a period of six weeks, which began the middle of June and ended July 24. The peak of activity at lights took place the first week of July in 1932. The periods of flight for all four years agree very closely.

Among the total captures of 118 individuals of *P. lorea* but 8 females were observed. Each female taken retained eggs in sufficient numbers to be considered gravid.

Polia olivacea Morr. A cutworm.

The larva of *P. olivacea* in its feeding does not frequently attack plants of much economic value. At least, reports indicating its destructiveness are rare. It lives on low-growing plants.

The moths have been taken in Canada and in the United States from Maine to Florida and California.

P. olivacea was somewhat more abundant than *P. lorea* during the period of this study. A total of 93 specimens of *P. olivacea* were taken in 1933, the year it was most plentiful. In 1934, captures numbered 64, and the flight extended over a slightly longer period than during the other years. In other respects, the time the moths were on the wing during 1932, 1933, and 1934 corresponded closely. Only one moth was captured in 1931. Flight, in general, extended from about July 15 to September 15. The height of activity as determined by light captures was attained during the last two weeks of August.

Total females numbered 42. Gravid females numbered 33. Many of the females when captured had already deposited a part of their eggs.

GENUS *Chabuata* WALKER

Chabuata signata Wlk.

This insect, interesting but unimportant economically, feeds upon a number of herbs. Plantain, dandelion, and other early growing plants are selected by the overwintering larvae during the warm days of spring, according to Bird (1925, pp. 182-183).

In its distribution *C. signata* is found from Canada to New Mexico.

No large numbers of moths were captured but the periods of activity during three of the years correspond so closely with each other that the data seem conclusive. *C. signata* has but one generation a year, according to the light-trap captures. Bird (loc. cit.) observed but one brood per season in New York. The time of flight was confined to August during both 1932 and 1933. In 1934, flight began early in August as in the preceding two years and differed only in that it extended into early September.

The total moths secured were 61. Females numbered 15 specimens, of which 14 were gravid. The eggs in the gravid females were abundant and generally fully developed.

Genus *Eriopyga* Guenée

Although five species of the genus *Eriopyga* are represented among the light-trap captures, namely, *E. oviduca, E. crenulata, E. cynica, E. vecors,* and *E. furfurata,* only *E. crenulata* was secured in large numbers.

Eriopyga crenulata Butl.

The food plants of this species have not been recorded. Some of the species of Eriopyga are cutworms and it is possible that *E. crenulata* feeds widely upon herbaceous plants.

The moths have been taken in eastern North America from Canada to Missouri and Colorado.

The adults of *E. crenulata* occurred at lights during July and the first two-thirds of August in the years 1932, 1933, and 1934. No moths were observed in 1933. The species is most numerous from the middle of July until early August. A total of 60 specimens was captured in the three years, of which 9 were females, 7 gravid.

Genus *Nephelodes* Guenée

Nephelodes minians Gn. The Bronzed Cutworm.

The bronzed cutworm is generally confined in its feeding to corn and other grains and grasses. Reports are rather frequent of its occurring in such numbers as to seriously injure grassland. At rare intervals the bronzed cutworm is known to attack plants in vegetable gardens.

The species ranges throughout the northern United States and Canada and its destructive habits have been observed in the Maritime Provinces of Canada, in New York, in Kansas, and elsewhere.

Over 500 moths of this species were captured at lights in the 1931-1934 period. The insect was abundant in 1933 and 1934, as in excess of 300 individuals were secured in each of those years. Captures at no time were observed prior to August 18 or later than September 29. (Figure 16.) A period of

three weeks, beginning the last week of August and extending through the two weeks of early September, covered the period of intensive flight.

N. minians is single brooded throughout its entire distribution. The moths are reported by Gibson (1915b, p. 29) to appear in August and September in Canada. In Illinois, Forbes (1905, p. 30) states the "moths first appear in early August, become most abundant during the first half of September, and continue into October." Lintner (1882, p. 107) also mentions the moths as appearing in August and September in New York.

Females of this species at lights were rare, as only 13 were observed among a total of 531 moths. All of the females were gravid and retained fully developed eggs.

Genus *Orthosia* Ochsenheimer

Orthosia hibisci Gn. Green Fruit Worm.

O. hibisci is the same insect as Slingerland's (1896, p. 577) *Xylina laticinerea* Grt. It is one of the green fruit worms frequently found eating into apples, pears, peaches, and other fruits. In addition to their fruit-eating habits, the larvae also feed upon the leaves of apple, soft maple, poplar, wild cherry, hickory, and box elder. (Slingerland, loc. cit., p. 570.) At widely separated periods of many years this species, in conjunction with moths of related habits, has caused much damage in the fruit districts of Nova Scotia (Sanders, G. E., and Dustan, A. G., 1919, p. 8) New York, Illinois, and Missouri (Slingerland and Crosby, 1915, p. 39).

O. hibisci is widely distributed in Canada and the United States. The insect has attracted most attention in the eastern and northern portions of the United States.

The moths of this green fruit worm were not observed in the fall of the year but captures were secured in May during three years. In 1933 a very heavy flight of *O. hibisci* was noted. On May 14, 299 moths were captured at one light-trap. Again, on May 19, 196 individuals were taken. The total records for 1933 consisted of 576 insects of this species, all secured during the period of May 12 to May 24. (Figure 17.) Only 8 moths in 1932 and 4 moths in 1934 came to the light-traps.

One moth in every three was a gravid female during the heavy flights of 1933. Females numbered 211 among the total captures of 588 moths during 1932-1934. Of the 193 gravid females, all bore well-developed eggs.

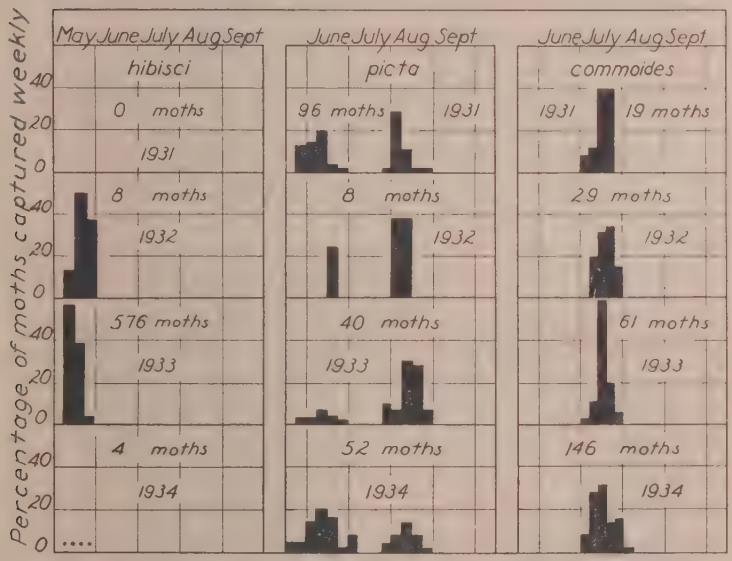

FIG. 17. A graphic summary of records of moths of the species *Orthosia hibisci* Gn., *Ceramica picta* Harr., and *Cirphis commoides* Gn. captured at lights during a period of four years.

The heavy flight of *O. hibisci* of over 500 moths in May, 1933, indicates the period of moth activity for the species during the years of abundance.

C. picta clearly gives evidence of two broods with peaks of moth activity in June and in August.

C. commoides has a period of flight confined to July except for a few moths that appear in early August.

GENUS *Ceramica* GUENÉE

Ceramica picta Harr. The Zebra Caterpillar.

The zebra caterpillar is a common garden pest in Canada and in the United States from the Atlantic States westward to Nebraska and Colorado.

The larva is a wide feeder on garden crops. In Nova Scotia, the chief damage is done by the second brood, according to Payne (1917, p. 49).

The moths of *C. picta* were taken each year during two separate periods indicating two distinct broods. (Figure 17.) The period of flight of the first brood extended from the end of May until July 2. The moths of the second brood occurred at the end of July and through August. The two broods were of about equal numbers. In 1931, and in 1934, the first brood moths were most abundant, but during the other two years the second generation moths were most numerous. Payne (1917, pp. 44-45) states that two generations of *C. picta* occur in the Maritime Provinces of Canada.

The total captures numbered 196 moths among which were observed 12 gravid females.

GENUS *Cirphis* WALKER

The larvae of this genus are cutworms which normally feed upon various grasses and become army worms only when abundant, according to Forbes (1926, p. 654). Six species, namely, *C. pseudargyria, C. multilinea, C. commoides, C. phragmatidocola, C. insueta* and *C. unipuncta,* were taken at light-traps during 1931 to 1934. *C. unipuncta* was very abundant during 1932 and 1933, when more than 400 moths were captured annually. *C. pseudargyria* and *C. multilinea* were secured in only relatively small numbers.

Cirphis commoides Gn. A Cutworm.

This insect has not proved to be an conomic pest in the past. The larva feeds upon various grasses.

The species is widely distributed over North America from Canada to Mexico.

C. commoides was captured in numbers that increased steadily from 1931 to 1934. (Figure 17.) The captures in 1931 consisted of 19 moths, but by 1934 the number rose to 146. The flight season is comparatively short. Flight captures were confined entirely to the month of July each year except for a few individuals observed during the first week of August in 1934.

Among the 255 moths of *C. commoides* recorded during the four years, occurred the small number of 19 females. Developed eggs were noted to be present among practically all the 14 gravid females.

Cirphis phragmitidicola Gn. The Yellow Army Worm.

This species is usually included among the army worms of the United States, although the records of its destruction on crops are rare. Vickery (1926, p. 1101) reports collecting *C. phragmitidicola* upon oats in Texas together with a number of other species of *Cirphis*. The larva normally feeds upon various grasses, including blue grass and wild rye (*Elymus virginicus* Willd.), according to Crumb (1927, p. 46).

The moths have been taken in Canada and throughout the United States east of the Rocky Mountains, and in California.

The flight period in Maine of *C. phragmitidicola* and *C. commoides* is very similar according to the observations of the writer. The captures at light traps were secured in largest numbers during July. In 1931 and 1934 a few moths were present in June, but the climax of flight was noted to be in July except in 1932. A small number of moths that year were on the wing during early August.

A total of 16 females, either fully or partly gravid, were taken among the 153 individuals of this species. The eggs were generally in a mature condition.

Cirphis insueta Gn. A Cutworm.

The larva feeds upon various grasses. This insect has not been reported as an economic pest of any importance.

C. insueta has a distribution which extends from Canada to Colorado.

A total of 496 moths were taken during the four years. In 1934, the insect was unusually abundant at lights and 295 individuals were recorded. Prior to 1934, between 41 and 89 moths were captured each year. *C. insueta* has a period of flight in June and July. (Figure 18.) Activity at light-traps was greatest in July each year. According to the writer's observations, there is but one brood in Maine. Forbes (1926, p. 654) indicates that two broods occur in New York.

Females of this species numbered 49 moths of which 42 were gravid. The dissected ovaries disclosed eggs in a well-developed condition.

Cirphis unipuncta Haw. The Army Worm.

C. unipuncta is the typical army worm. Certain other Noctuid larvae because of habits similar to this species are fre-

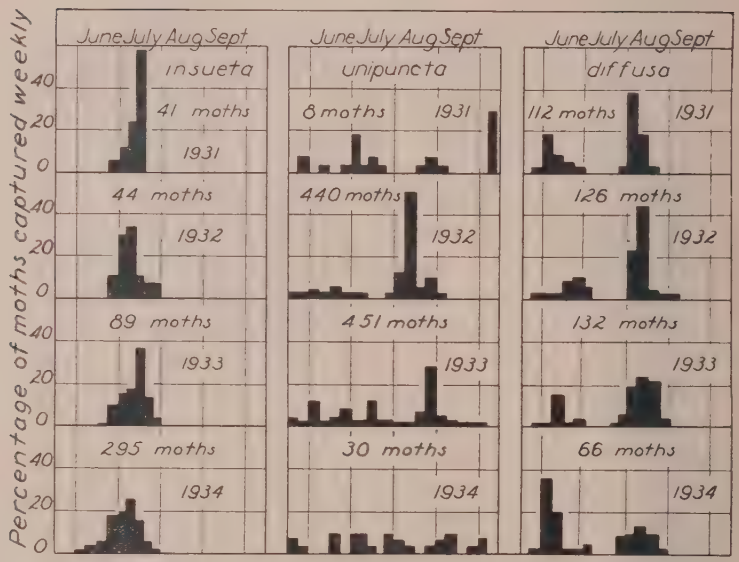

FIG. 18. A graphic summary of records of moths of the species *Cirphis insueta* Gn., *Cirphis unipuncta* Haw., and *Nelcucania diffusa* Wlk. captured at lights during a period of four years.

C. insueta has one brood at Orono. Adult activity takes place in June and July with a climax of flight about July 16.

C. unipuncta apparently has two broods as indicated by the charts for 1932 and 1933. The broods are not clearly defined.

N. diffusa has two broods with maxima of flights during June and August.

quently designated as army worms. By preference the larvae of *C. unipuncta* feed upon wild grasses growing on low ground, according to Knight (1916, p. 753). Red top (*Agrostis alba*), timothy, bluegrass, couch and orchard grass are freely eaten, as well as other wild and cultivated grasses. When pressed by hunger the army worm feeds upon unripe wheat, oats or rye, and upon corn, alfalfa, clovers, and other plants.

The army worm moth is common in its distribution from Canada to Chile. In the United States, that portion of the country lying in the Missouri, Mississippi, and Ohio River Valleys is most subject to outbreaks of the species as an economic pest. In one or another portion of this area, a serious outbreak occurs practically every year. In any one area the intervals between serious outbreaks are irregular, usually not ex-

ceeding a few years. Reports of injury are not common in Maine.

C. unipuncta was erratic in respect to the time at which it appeared at lights. In 1931, only 8 moths were captured, but these were distributed over each month of the summer. In 1932, the specimens captured totaled 440. Two well-defined broods were apparent for that year. (Figure 18.) The first generation of moths came to lights in May, June, and early July. The second generation was marked by a heavy flight in August, while straggling numbers appeared until early September. In 1933, a few more moths were taken than in the previous year. The captures were more scattered, however, and not so clearly defined into two broods. During 1933, moths in greatest numbers were obtained in June and August, but a few individuals appeared at lights each week of the season from May 12 until October 6.

During 1934, but 30 moths of *C. unipuncta* came to the light-trap. The captures were irregularly distributed over the six-month season.

In general, the evidence for 1933 and 1934 indicates two broods. When the two broods were compared in numbers, the second brood in August and September was found to be the larger.

Gibson (1915a, p. 10) reports two annual broods in Canada, "the moths appearing in June and again in August and September, specimens even occurring abundantly some years in October." At Lafayette, Indiana, Davis and Satterthwait (1918, p. 800) found that three complete generations occurred and in some seasons a partial fourth was possible.

Females were common at lights during this study. A total of 428 or 45 per cent of all specimens were females. About 80 per cent of all females were gravid. The eggs generally were in an immature condition and the abdomens filled with fat.

Genus *Neleucania* Smith

Neleucania albilinea Gn. form *diffusa* Wlk. Wheat-head Army Worm.

The larva normally feeds upon various species of grass, preferring especially the heads. At times it becomes abundant

in cultivated fields, where it may do great damage to the heads of small grains and timothy, to corn and other crops.

The insect is common in Canada and in the United States north of the latitude of the Ohio River and east of the Rocky Mountains. Farther south it occurs in Kentucky, Texas, New Mexico, and Arizona.

This moth was abundant each year, as over 100 specimens were secured yearly except in 1934 when its numbers were somewhat reduced. Two well-defined broods were observed each summer. (Figure 18.) The period of flight for the individuals of the first brood began in late May and continued until the end of June or early July. Moths of the second brood were captured from the end of July until about September 1. During 1931, 1932, and 1933, the second brood moths were more numerous than those of the first brood.

The proportion of females to males was low. A total of 436 moths was captured during the four years. The females numbered 57 specimens. Well developed eggs were observed in the case of the 52 gravid moths.

Forbes (1905, p. 84) has reported that two generations of the wheat-head army worm are found in Illinois. He states that the moths of the first generation come out in May, while those of the second brood emerge in late July and August.

GENUS *Leucania* OCHSENHEIMER

Leucania luteopallens Sm.

This insect, in common with the members of the two previous genera, is also a grass feeder. It is widely distributed and generally common from eastern Canada to California.

Only 1 specimen of this moth was obtained in 1931, while in 1934, 229 individuals were secured. This illustrates the wide variation in abundance that may take place during a period of a few years in the case of many common moths.

The flight period of *L. luteopallens* was confined to a period beginning at the end of June and extending until early September. (Figure 19.) Over 90 per cent of the captures were secured between July 5 and August 20. But one brood is evident.

The males far outnumbered the females of this species. Among the 354 moths captured were 23 females, 21 gravid.

FIG. 19. A graphic summary of records of moths of the species *Leucania luteopallens* Sm., *Cucullia intermedia* Speyer, and *Septis lignicolor* Gn. captured at lights during a period of four years

The flight of *L. luteopallens* takes place between late June and early September with a climax about July 25.

C. intermedia apparently has two broods of moths with maxima of flights in June and in late July or August.

S. lignicolor has a period of flight confined to late June and the month of July.

GENUS *Cucullia* SCHRANK

In addition to *C. intermedia*, two other species of *Cucullia* were taken at lights, namely, *C. florea* and *C. convexipennis*. Except in 1931, specimens of *C. florea* and *C. convexipennis* came to the light-trap in small numbers each year. Members of this genus are not economically important insects. The larvae are feeders on a wide variety of common plants. They have been observed to prefer the flowers.

Cucullia intermedia Speyer.

This species occurs from Canada to Virginia, and westward to Kentucky and Missouri.

In 1934, 110 moths of this insect occurred at the light-traps. Less numbers were observed the other three years. The flight of *C. intermedia* during this study strongly suggests two broods, except in 1931 when only 12 moths were captured. (Figure 19.) The heavy flights of 1934 were observed to come during two distinct periods of abundance which indicated two broods. The two generations overlapped to some extent in July. According to the writer's observations the climax of flight for the first brood comes in June, while that of the second brood generally takes place at the end of July or in August. The entire period of moth activity at lights extended from May 19 to September 8 during 1934.

GENUS *Septis* HÜBNER

The larvae of this genus live well hidden in the ground among roots on low-growing plants and grasses. All species are cutworms. The three species, *S. apamiformis, S. suffusca,* and *S. rorulenta,* in addition to the three species given below were taken by the writer in the course of this study. These six *Septis* moths have a common flight period during July when the members of each species may be taken at lights.

Septis verbascoides Gn. A Cutworm.

Although this insect is a cutworm it has not developed sufficiently destructive habits to attract attention.

S. verbascoides is a fairly common species in its distribution from Canada to Pennsylvania and Virginia.

The 1934 observations were based upon 42 moths and showed a well defined period of flight beginning in late June and extending until late August. The moths were captured in greatest numbers during the last half of July. During 1931, 1932, and 1933, moths were captured well within the limits indicated in 1934.

Females were much more frequent at lights than males. Among the total captures of 74 moths for the four years, the females numbered 55 and males 19. The eggs were generally in an undeveloped condition. Approximately one-third of the

females, upon dissection, showed eggs in a stage ready for oviposition. In the other moths, the eggs were not completely developed.

Septis lignicolor Gn. A Cutworm.

As an economic pest, this cutworm is not important. Its presence in grassland, corn fields, and elsewhere has been reported by a number of investigators but never as a very destructive insect.

The moths have been taken in Canada and over a wide territory in the United States from New England to Illinois, Arizona, and California.

S. lignicolor was present in consistent numbers each year. Sixty moths, the largest number for one year, were captured in 1931, and 29 moths, the smallest number, were taker in 1933. Each year, a large majority of the flight came in July. (Figure 19.) The entire period of moth activity as measured by light-trap captures extended from June 18 to August 2.

The total captures consisted of 155 specimens. Forty-five or about one-third of the moths were females. With a single exception, all of the females were gravid. The eggs were found to be well developed. Gillette (1891, p. 544) reports that this moth is common from June 14 to July 16 in Central Iowa. The females he examined were well filled with eggs.

Septis arctica Boisd. Yellow-headed Cutworm.

The yellow-headed cutworm lives one to two inches in the soil, feeding primarily on the under-ground parts of grasses, small grains, and corn. Less frequently, it is known to attack a number of garden vegetables.

The range of this moth extends from Labrador to Virginia and westward to Colorado and California. In the northern United States and in Canada it is generally common.

S. arctica came to lights in greater abundance than any other species of this genus. Over 200 moths were secured during the four years. The time of flight for all years corresponds closely. The moths were on the wing and came to lights in about equal numbers during July and August. (Figure 20.) With the exception of 1931, a few moths were captured each year in early September, also.

In Ontario, the moths are found during June, July, and August, according to the observations of Gibson (1915b, p. 26).

Forbes (1905, p. 21) reports that under Illinois conditions the moths make their appearance in late June, are most common in July and early August, and remain on the wing until September.

Females were more common than males. Among the total captures of 233 specimens, 180 females were observed. Gravid specimens numbered 169. The eggs were abundant and well developed.

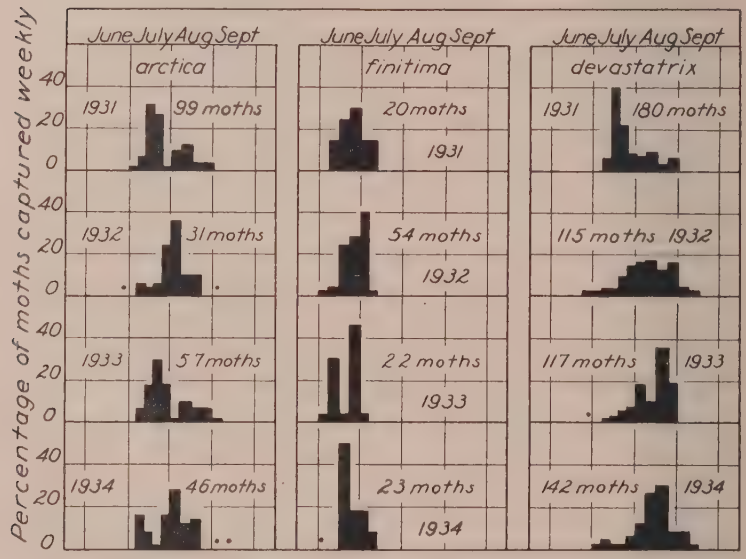

FIG. 20. A graphic summary of records of moths of the species *Septis arctica* Lef., *Trachea finitima* Gn., and *Sidemia devastatrix* Brace, captured at lights during a period of four years.

S. arctica has one brood with the moths in flight during July and August.

The flight of *T. finitima* comes in June and early July. One brood is clearly indicated.

S. devastatrix has a flight period from the last of June until early September. One brood is indicated with moth activity usually greatest in August.

GENUS *Trachea* HÜBNER

Few details of the habits of the species in the genus *Trachea* are known. A number of species have been recorded as feeding upon grass in the larval stage. Others have been found on smilax. The group contains no seriously noxious insect. *Trachea*

finitima was the most prevalent moth of this group during this study. In addition, four other members were taken: *T. illocata, T. remissa indocilis, T. modica,* and *T. impulsa.*

Trachea finitima Gn. The "Brome-grass Cutworm."

Criddle (1920, pp. 121-122) proposed the name brome-grass cutworm for this insect after observing its occurrence in large numbers in brome-grass fields in Manitoba. He states that it attacks the young shoots of various grasses but shows a marked preference for brome-grass.

J. H. Hawkins (investigations unpublished), of the Maine Agricultural Experiment Station, reports from observations made in Aroostook County, Maine, that the larva feeds upon the kernels of unripe wheat and upon timothy heads.

T. finitima has a northern distribution in the United States and in Canada it ranges from Manitoba to Alberta.

The moths came to lights in June and the first half of July. They were obtained in greatest numbers from June 10 until July 5. (Figure 20.) No specimens were secured after July 12.

Criddle (loc. cit.) found in Manitoba that the moths were on the wing during June but were commonest during the first two weeks.

An unusually high ratio of females to males was recorded for *T. finitima.* There were 98 females and 21 males among the moths. Well-developed eggs were observed frequently in the 92 gravid females. However, a few moths secured early in the period of flight contained immature eggs.

Genus *Oligia* Hübner

Oligia bridghami G. & R.

This moth occurs in the eastern United States. The food of the larva has not been studied.

The captures of *O. bridghami* were: in 1931, 0 moths; in 1932, 5 moths; in 1933, 23 moths; and in 1934, 54 moths. The records for the last two years are sufficiently numerous to show a definite period of flight extending from July 12 until September 4.

There were 85 moths taken during the four years, and of this number 20 were females. Dissections showed well developed eggs.

Oligia fractilinea Grt. form *vulgivaga* Morr. Lined Corn Borer.

The larva of this insect is reported by Drake and Decker (1927, p. 8) as primarily a timothy feeder and as a minor pest on corn.

It is found in Canada and is widely distributed in the United States from the eastern states to Colorado and New Mexico.

A total of 30 moths were taken during the last three years of this study. The moths were most common from August 1 to August 20, although the entire period of flight extended from July 19 until August 26.

Oligia diversicolor Morr.

The larva feeds upon a species of sedge (*Scirpus cyperinus* Kunth.).

The known distribution in the United States is restricted to Maine, New Hampshire, Massachusetts, and New York.

In 1933 and 1934, the combined captures of this insect approximated 100 specimens. The moths were on the wing and came to lights between August 17 and October 2. The climax of flight was observed during the first two weeks of September.

Only 13 females, all of which were gravid, were recorded among the 125 moths comprising the four-year catch.

GENUS *Agroperina* HAMPSON

Agroperina dubitans Wlk.

The food plants of the larva have not been listed. The closely related species *A. laterita* Hubn. is a cutworm.

The moth has been taken in New York, Pennsylvania, Ohio, and other eastern states. It also occurs in Canada.

A. dubitans was captured during each of the years of this study, but not in large numbers except in 1934 when 49 specimens were secured.

Flight in 1934 began July 12 and extended to September 15. A two-weeks period from August 14 to August 28 covered the time in which the moths were on the wing in greatest numbers.

The total captures for this species numbered 85 moths. Among these were 21 gravid females. Dissection of the females in every instance disclosed the eggs to be well developed.

Agroperina cogitata Sm.

This species is closely related to *A. dubitans* and by some authorities is considered to be a form of it.

Distribution occurs from Canada to California. There were 62 moths that came to the light-traps during the 1931-1934 interval. The greatest number for one year was 23 specimens in 1934. The flight of *A. cogitata* was earlier in the season than that of *A. dubitans*. Each year all captures were recorded during July, except 3 moths taken in late June in 1934.

Only 11 gravid females were captured.

Genus *Sidemia* Staudinger

Sidemia devastatrix Brace. The Glassy Cutworm.

Due to its underground feeding habits, this species is similar to *Septis arctica*. The larva rarely comes to the surface to feed but works in a burrow below ground. The roots and basal parts of stems are attacked. The glassy cutworm is a noxious pest upon grasses of various kinds, small grains, and corn. Garden plants such as beans, lettuce, cabbages, and strawberries are also at times subject to its depredations. An excellent review of the hosts and activities of this insect is given by Crumb (1929, pp. 99-100).

S. devastatrix is found widely distributed over the United States but it is most abundant in the North. In Canada it occurs as a common insect from Nova Scotia to British Columbia.

Each year of this study over 100 specimens of the glassy cutworm were obtained. The moths are on the wing and frequent lights from the last days of June until early September. The one brood of adults appeared throughout a period of 10 or 12 weeks. (Figure 20.) The moths were most abundant in August during three years of this study. In 1931, however, the peak of activity came in July.

Females of *S. devastatrix* were not abundant. Among 554 specimens were found only 66 females. All but 2 of the females were gravid. Dissected moths showed eggs in nearly every case mature and ready for oviposition.

All life history investigations on the glassy cutworm indicate one brood. Norman (1875, p. 6) reports that the moth is common from June 24 to September at St. Catherines, On-

tario. The moths fly from late June until the middle of September under Ontario conditions, according to Gibson (1915b, p. 25). In Iowa, Gillette (1891, p. 540) states that moths have been captured from late June until the middle of September. Slingerland in 1889 (1902, pp. 210-211) took large numbers of the moths in six light-traps at Ithaca, New York, from June 15 until September 1.

GENUS *Phlogophora*

Phlogophora iris Gn. A Cutworm.

As an economic pest, this insect is not important. Forbes (1923b, p. 282) reports that the larva is a cutworm in habits. The moth is found in the North Atlantic States. Moore (1930, p. 14) states that it has been taken in northern Michigan.

P. iris was captured in small numbers each year. The moths were most numerous in 1934 and during that year 33 individuals were obtained. The moths were on the wing and came to light during June and July. No specimens were observed prior to June 15 except 3 moths obtained in 1934. During 1931, 1932, and 1934, a two-weeks' period at the end of June proved to be the time of greatest abundance.

Females of *P. iris* were more frequent at lights than males. The ovaries of the 39 gravid females that were examined showed well-developed eggs.

GENUS *Acronycta* OCHSENHEIMER

Although 12 species in the genus Acronycta are represented among the captures secured during this four-year study, no species was abundant at lights. The following table gives for each species the number of moths observed and the food plants of the larvae:

The food plants of the larvae are those reported by Smith and Dyar (1899, pp. 1-194) in a monograph upon the Acronycta and their allies. In general, the foliage of many deciduous trees is selected by the caterpillars of the Acronycta. The flight period for the moths in not a single case was later than August 8. According to data in the table, the moths are most commonly on the wing during June and July.

TABLE 2

Food Plants of the Larvae in the Genus Acronycta

	Total moths secured in four years	Time of capture	Food plants of larvae
A. VINNULA Grt.	2	July	Elm
A. TRISTIS Sm.	2	Middle July	Not known
A. NOCTIVAGA Grt.	1	Early June	Poplar, various low plants
A. GRISEA Wlk.	1	Late June	Apple, birch, elm, willow, arrowwood
A. HASTA Gn.	3	June	Not known
A. MORULA G. & R.	18	June to middle July	Elm, apple, linden
A. LEPORINA L.	1	July	Poplar, willow, birch
A. INNOTATA Gn.	4	July and early August	Probably hickory
A. AMERICANA Harr.	3	July	Maple, elm, poplar, birch, alder, and others
A. DACTYLINA Grt.	32	Early June to early August	Alder, willow, birch
A. IMPRESSA Wlk.	3	July and early August	Willow, plum, hazel, currant, blackberry
A. DISTANS Grt.	1	Late May	Poplar, willow, birch, alder

Acronycta dactylina Grt.

A. dactylina was the most abundant species of Acronycta, but only 32 moths were taken during the 1931-1934 interval. Apparently, the moths of this group are not readily attracted to lights.

"This species is quite widely distributed north of the Potomac and west to the Rocky Mountains, but does not extend very far north of the Canadian line," quoting from Smith and Dyar (loc. cit., p. 5).

Most of the specimens were captured in July. A small number of moths were obtained during the last half of June, however, during each year that *A. dactylina* came to lights. In 1932 and in 1933 a few individuals were observed in early August.

Genus *Simyra* Ochsenheimer

Simyra henrici Grt.

The recent synonomy of this insect indicates that it should be designated as *Arsilonche albovenosa henrici* Grt. The larvae feed upon grass, smartweed, and willow, according to Smith and Dyar (1899, p. 177).

A. albovenosa henrici is generally distributed over the United States and also occurs in Canada and Europe. It is a common moth throughout many Eastern States.

This noctuid has two broods of moths at Orono. The time the moths are on the wing is indicated in Figure 21. The first generation of adults occurred in May and June. The second generation of adults began to appear at lights about the 20th of July and activity extended until approximately August 29. Each year the individuals of the second brood were the more abundant of the two generations.

Although a total of 147 moths were captured during this four-year study, only 9 were females.

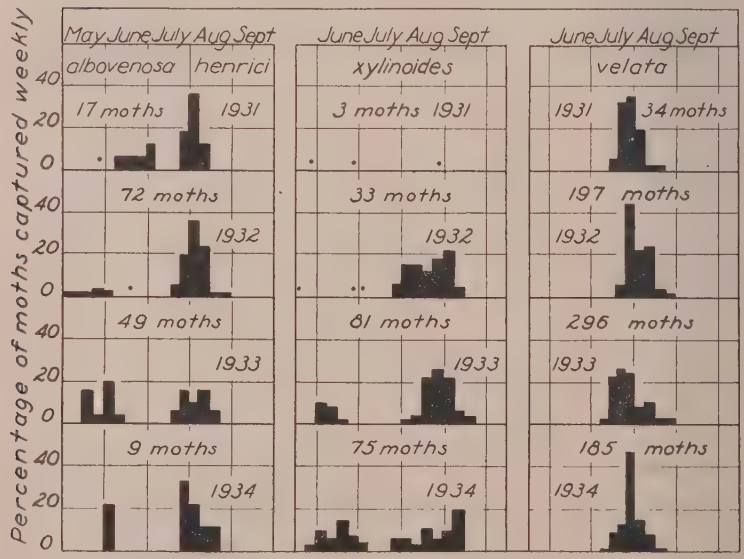

FIG. 21. A graphic summary of records of moths of the species *Arsilonche albovenosa henrici* Grt., *Hyppa xylinoides* Gn., and *Apamea velata* Wlk. captured at lights during a period of four years.

A. albovenosa henrici has two broods at Orono. The first brood in May and June is not as numerous as the second brood in late July and August.

The flight of *H. xylinoides* clearly indicates two broods of moths. The charts for 1933 and 1934 substantiate this fact. The moths are abundant in June and again in August or early September.

A. velata has a flight during July and August. Maximum numbers appear in late July each year.

Genus *Hyppa* Duponchel

Hyppa xylinoides Gn.

This insect is not a seriously noxious pest. The larvae are reported by Forbes (1926, p. 641) to be general feeders. Phipps (1930, p. 176) in his studies on blueberry insects observed that the larvae readily accept leaves of the blueberry and huckleberry under laboratory conditions.

The New England and the Atlantic States comprise the area of the reported distribution for this moth.

H. xylinoides was a common moth during 1933 and 1934 as over 150 specimens came to lights in those years. Fewer numbers were observed in 1931 and 1932.

The light-trap captures of 1933 and 1934 definitely showed two broods. The moths of the first generation were present from the last of May until early July. Moths of the second brood were on the wing from the last part of July until September 15 or September 20. (Figure 21.) Many more specimens were obtained from the second generation than from the first generation, indicating that the second brood is the more abundant.

In the four-year interval, 192 moths were obtained. Females numbered 55 of which 52 were partially or fully gravid. Dissected females showed a wide variation in the development of the eggs. Many females had ovaries with immature eggs while other moths had eggs in a fully developed state.

Genus *Prodenia* Guenée

Prodenia ornithogalli Gn. The Cotton Cutworm or Yellow-striped Army Worm.

Six specimens of *P. ornithogalli* were taken at Orono during this study. The moths evidently are stray migrants from the South. The captures occurred during September in every instance. The larva is a wide feeder upon low plants. Field crops as well as garden crops frequently suffer from the depredations of this cutworm in the Southern States.

GENUS *Laphygma* GUENÉE

Laphygma frugiperda A. & S. The Fall Army Worm.

In 1931, three stray migrants of the fall army worm were captured during early October. *L. frugiperda* is able to survive the winters only in the warmer parts of the South. The species redistributes itself each year, through migration of the moths over most of the United States east of the Rocky Mountains. Stray migrants are reported from Canada late in the season. An extensive list of the food plants and the general biology of the insect are given by Luginbill (1928).

GENUS *Apamea* OCHSENHEIMER

Apamea velata Wlk.

The larvae bore in sedges. (*Carex* spp.)

This species is found from Canada to Virginia and westward to the Mississippi River. It also has been taken in Missouri and Iowa.

A. velata was one of the most abundant noctuids during this study; over 700 moths were recorded in the four-year period.

The moths were on the wing and came to lights in July and August. The earliest moths captured were taken July 7 and none were observed after August 29. The climax of flight came at the end of July each year. (Figure 21.)

Smith (1899, p. 17) states that in New Jersey the time of flight is during June, July, and August.

Females were common at lights. There were 338 females among the 712 specimens of this species. Each year the females outnumbered the males during the last 2 or 3 weeks of the flight period. Among the females, 304 were gravid. Every condition of the eggs was found from very early stages to those in condition ready for oviposition. Many moths were not fully gravid but had deposited a portion of their eggs before they were captured.

Apamea nictitans L. form *americana* Speyer.

In Europe the larva of *A. nictitans* is reported to feed upon grass. In this country observations indicate that in addition to

feeding on grasses, the larvae also occur upon sedges (Forbes, 1926, p. 639). It is not an economic pest.

The range of this insect includes a wide expanse of North America from Canada southward to Virginia, and westward to Colorado and California.

In abundance at the light, this insect increased from 35 specimens captured in 1931 to 1,033 individuals taken in 1934. During 1934, more specimens of this insect were recorded than of any other noctuid.

No marked variations between periods of flight for the different years were observed. The inclusive dates of all captures extended from July 14 to October 6. August was the

Fig. 22. A graphic summary of records of moths of the species *Apamea nictitans americana* Speyer, *Gortyna micacea* Esp., *Caenurgia erechtea* Cram., and *C. crassiuscula* Haw. captured at lights during a period of four years.

The flight of *A. nictitans americana* takes place from approximately July 15 to September 30. A marked increase in abundance was observed between 1931 and 1934.

G. micacea has one brood of moths with the period of activity extending from mid-July to mid-September. Adults are most numerous in August.

C. erechtea and *C. crassiusculata* have similar flights. Two broods are clearly indicated. The maxima of abundance usually come in May and late July.

month during which specimens were secured in greatest numbers. (Figure 22.) The climax of activity each year was approximately the middle of August.

Forbes (1923b, p. 155) reports that a flight occurs in July and August at Ithaca, New York. Smith (1899, p. 19) states that from the middle of July to the beginning of September is the time of moth activity in Illinois.

There were 242 females found in the total catch of 1,774 moths. Among the females occurred 213 individuals that were gravid. As in *A. velata* the condition of the ovaries was highly variable.

GENUS *Gortyna* OCHSENHEIMER

Gortyna micacea Esp. The Potato-stem Borer.

The larvae bore in corn, tomatoes, potatoes, rhubarb, peas, and other garden vegetables, as well as in the stems of iris, lily, dahlia, and other flowering plants, according to Gibson (1928, p. 42). In England the insect is known as the potato-stem borer. In Nova Scotia the eggs have been found upon couchgrass.

G. micacea has an extensive distribution in Europe and Asia. On the American continent it is found in Eastern Canada and the Northeastern United States. Its status in Canada, whether as a native or imported insect, is not definitely known. At Orono, Maine, it is a common moth. Forbes (1926, p. 638) does not report its presence in New York.

The abundance of *G. micacea* is indicated by the fact that nearly 600 specimens were captured in the 1931-1934 interval. Figure 22 shows for the four years a uniform period, beginning in mid-July and extending until early September, during which the adult stage of this insect was captured at lights. The time of greatest abundance came during early August in 1931, 1932, and 1933.

The males at lights were much more frequent than females, and only 21 females were caught abong 597 moths of both sexes. Nineteen of the females were gravid.

GENUS *Papaipema* SMITH

The writer is indebted to Mr. Henry Bird, of Rye, New York, for the determination of species in this genus. The host

plants listed here are also the result of researches upon the life histories of Papaipema by Mr. Bird. Only a few moths of this group came to the light traps. All captures were secured during the period of late August to early October.

TABLE 3

Food Plants of the Larvae in the Genus Papaipema

Species	Total number moths captured in the four years	Food Plants
P. INQUAESITA G. & R.	18	"Sensitive fern," Onoclea sensibilis.
P. MARGINIDENS Gn.	8	"Water hemlock," Cicuta maculata, and other large umbellifers.
P. NEPHELEPTENA Dyar	2	"Balmony," Chelone glabra.
P. PURPURIFASCIA G. & R.	8	Aquilegia canadensis and cultivated varieties of Columbine.
P. PTERISII Bird	12	"Brake fern," Pteris aquilina.
P. LYSIMACHIAE Bird	1	"Loosestrife," Lysimachia.
P. FRIGIDA Sm.	23	"Meadow rue," Thalictrum.
P. NEBRIS Gn. form NITELA Gn.	6	"Ragweeds," Ambrosia.

P. purpurifascia is an economic pest on cultivated Columbine. *P. nebris* (the common stalk borer) at times is a serious pest that bores in corn, tomatoes, potato, cosmos, calendula, and other plants with thick stems (Lowry, 1927, p. 9).

Genus *Caenurgia* Walker

Caenurgia erechtea Cram. Clover Looper.
Caenurgia crassiuscula Haw.

These two moths are very similar so that identification is slow and tedious except with unblemished specimens. Also, they have similar life histories and at times outnumbered all moths of all other species combined. Except during 1934 the captures at light-traps were therefore not tabulated separately.

C. crassiuscula in the larval stage feeds upon grass and other common herbaceous plants. It is not an insect with destructive habits.

C. erechtea is commonly known as the clover looper. The larvae feed upon clover and other herbs, but their depredations are not of a serious nature. Garman (p. 45, 1906) reports that the larvae devour clover leaves, but the loopers are scattered

among the plants. He definitely observed that the individual plants were not killed.

In their distribution, *C. erechtea* and *C. crassiuscula* are found throughout the Atlantic States and westward to Colorado.

For reasons given previously, during the first three years of this study, no attempt was made to separate these two species of *Caenurgia*. In 1934, the captures were less abundant and the two species were not combined. *C. erechtea* was almost three times as common as *C. crassiuscula* during that year; 218 moths of the former species were obtained in comparison with only 83 moths of the latter. Throughout the entire four years it was concluded, from such identifications as were made, that *C. erechtea* came to lights in far larger numbers than did *C. crassiuscula*. On the basis of this conclusion, *C. erechtea* was captured at lights more frequently than any other noctuid moth during 1931 to 1934, and over 5,000 specimens of the two moths were taken in this study. An extremely abundant catch of 2,793 moths of the combined species was secured in 1932.

The existence of two broods of both *C. crassiuscula* and *C. erechtea* is clearly shown by the captures. Figure 22 gives these data in graphic form. The occurrence of the broods of the two species was practically simultaneous in 1934.

Forbes (1923b, p. 157) states that two broods of *C. crassiuscula* are found in New York, one in May and the other in August.

C. erechtea is reported by Gossard (1911, p. 80) to have two broods in Ohio.

Less than 10 per cent of the captured members of *Caenurgia* were females. In the total of 5,240 specimens, 344 females were found. The gravid females numbered 315, many of which had already deposited a portion of their eggs. Dissected females, when gravid, showed mature eggs in nearly all cases.

GENUS *Autographa* HÜBNER

A large number of representatives of this genus were secured in the course of this study. Within the confines of New York 21 species of Autographa have been collected, according

to Forbes (1926, p. 626-7). At Orono, 16 species of this group came to light-traps during the period of 1931 to 1934. In the case of some of these species, individuals were taken rarely. In fact, 7 species of Autographa are represented among a total of 20 captured moths.

Autographa falcigera Kirby. Celery Looper.

The larvae of *A. falcigera* have been reared upon celery, lettuce, and sugar beets, according to Chittenden (1902a, p. 73). In addition, the loopers feed upon many common herbaceous plants. As a pest on garden vegetables this insect usually does not become destructive enough to require control measures.

A. falcigera is found throughout the length and breadth of the United States. However, Chittenden (1902a, p. 74) reports that it appears to be most common in the Transition zone.

No other species of the genus *Autographa* came to light-traps in such large numbers. Over 600 moths made up the total captures for the four years. During 1932 and 1934, the insect was particularly abundant with a record of over 200 specimens yearly.

The captures show that the adults are common throughout the season from the end of May to early October. There were no intervals during which the moths were not on the wing, by which the broods could be differentiated. (Figure 23.) However, two overlapping broods seem evident. The first brood was abundant either at the end of June or early in July. The entire period of flight for this early generation extended from May until the middle of July.

The second brood of moths became active during late July and continued on the wing through August and September. The individuals of the second brood were generally most abundant during the first half of August. A decrease in numbers was observed throughout September.

Coquillett (1892, p. 38) found that three generations were common in Illinois. He states that the moths were abundant in late April and early May and again in late July and early August, and the third brood finally appeared in late September. In New York, Forbes (1923b, p. 157) reports that captures at light-traps showed one well-marked brood in May and strag-

glers later. He states that "there are supposed to be two or three broods."

There were only 41 females among the 644 moths of *A. falcigera*. Gravid females numbered but 21. A number of the gravid females had eggs in an undeveloped condition; other females contained fully matured eggs.

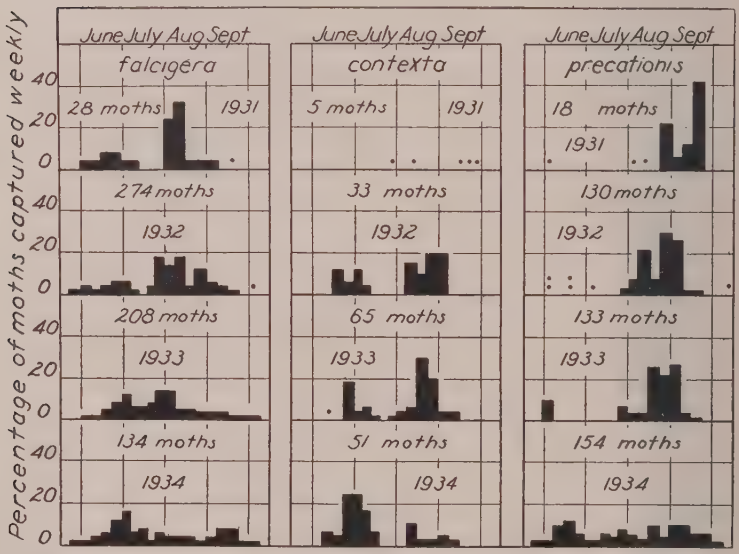

FIG. 23. A graphic summary of records of moths of the species *Autographa falcigera* Kirby, *Autographa contexta* Grt., and *Autographa precationis* Gn. captured at lights during a period of four years.

Two overlapping broods of moths are indicated for *A. falcigera*. Maxima of moth abundance take place first in late June or early in July and secondly in August or September.

A. contexta has two broods with peaks of abundance in late June or early July and again in late August.

A. precationis apparently has two broods but with the first brood greatly reduced some years. The moths are usually most abundant in August and September.

Autographa brassicae Riley. Cabbage Looper.

The loopers of *A. brassicae* attack cabbage, turnip, cauliflower, radish, lettuce, and many other plants. Without question, this species is the most destructive of any in the genus. Chittenden (1902a, p. 64) states that in the Southern States,

where there may be as many as four to six generations, it is particularly destructive to cabbage and related plants.

This species is widely distributed throughout the United States east of the Rocky Mountains from Maine to the Gulf States.

In 1934, 16 moths of *A. brassicae* were captured at lights. The total catch for the four years consisted of 29 individuals. The seasonal distribution of the captured moths suggests two broods in Maine, one in July and the other in August and September.

Few individuals survive the winter season in the North, according to Chittenden (1902a, p. 66).

Autographa festucae putnami Grt.

Forbes (1926, p. 627) states that the larvae feed upon grasses and other monocotyledons.

A. festucae putnami is distributed in the eastern part of the United States and also in Europe. Moore (1930, p. 17) reports securing the moths on the Beaver Islands in northern Michigan.

The observations of this species suggest two broods. In 1934, the greatest catch of 64 moths for any one year was obtained, and for that year two broods seemed evident. A well-marked first brood, beginning about mid-June and ending near July 25, was observed during three of the years. A few moths, which were taken in August and September, appeared to suggest a second brood. The possibility of two generations is strengthened by the results obtained for *A. contexta*. During the last year of this study, the moths of both species were on the wing during very similar periods.

The total specimens numbered 122; among these there were 10 females, all of which were gravid.

Autographa contexta Grt.

This species also feeds upon grasses. The distribution of *A. contexta* in the United States covers the same territory as that of *A. festucae putnami*. *A. contexta* is not found in Europe.

During three years of this study, *A. contexta* was secured in fairly large numbers. When one year is compared with another, the periods of flight are seen to be similar. That *A. contexta* has two broods is very evident, according to the data

obtained by the writer. (Figure 23.) The first generation moths were on the wing during late June and the first half of July. The moths of the second generation were captured from August 1 until about September 15. The individuals of the second generation were more abundant than those of the first in 1932 and again in 1933. During 1934, the members of the first brood outranked those of the second in abundance.

Forbes (1926, p. 627) reports that he observed two broods for this species in New York; the first appeared in June, and the second in August.

The females were not numerous among the captures of this species. Only 17 females, in a total of 164 moths, were secured. Fully developed eggs were found in some of the 15 gravid moths.

Autographa precationis Gn. "Eyed-cabbage Looper."

The larvae have been collected from a number of plants, such as cabbage, hollyhock, morning-glory, pigweed, thistle, and other herbaceous plants. Chittenden (1902a, p. 69-72) states that it is a fairly common insect on cabbage and he proposed the name of "Eyed-cabbage Looper" for it.

This species ranges throughout the United States east of the Rocky Mountains and also in Canada.

Large numbers of *A. precationis* came to lights during 1932, 1933, and 1934. Over 400 moths were captured in those years. From the light-trap data, two broods seem evident. The moths of the first generation, which appeared from late May until early July, were very few except in 1934. (Figure 23.) The flight of the second brood extended through August and September. The members of the second brood comprised at least 95 per cent of the entire yearly captures in 1931, 1932, and 1933. During 1934, the flights of *A. precationis* were radically different from those of the three previous years. In 1934, specimens were secured all through the season from late May to early October. A well-marked brood appeared in June. The large number of captures in August and September indicate the second brood. The mid-season moths (in July and early August) may have been stragglers of the first brood, or early members of the second generation.

About one specimen in every five was a female. The total

moths numbered 435 of which 87 were females. The condition of the eggs varied widely. Many moths had already deposited their eggs when captured. In fact, 20 specimens were in this condition. On the other hand, a number of specimens disclosed an immature stage of ovarian development. A third group of females showed eggs mature or nearly so.

Genus *Plusia* Hübner

Plusia aereoides Grt.

The larvae feed upon Spiraea, according to Holland (1903, p. 237).

This species is found from Nova Scotia to Florida and westward to Texas and the Rocky Mountains.

P. aereoides had a period of flight during July and early August. The data of the different years for the time of activity show much uniformity. Of the 141 specimens captured, all but 12 moths were secured in July.

Only 17 females were obtained during this study. The 12 gravid moths, with one exception, had developed eggs in their ovaries.

Genus *Raphia* Hübner

Raphia frater Grt.

Poplar is the food of the larvae of *R. frater,* according to Forbes (1926, p. 626).

The moth is found throughout the eastern part of the United States. Moore (1930, p. 17) states that it is very abundant at lights in northern Michigan.

R. frater was not taken in extensive numbers. In 1934, the year of greatest abundance, 23 moths were captured. There is a single brood at Orono, with a period of flight beginning in June and reaching a climax in July. If all four years are considered, the entire interval of activity extended from June 1 to August 12. However, over 75 per cent of all moths were captured during July.

About one-third of all specimens were females; 13 individuals of this sex were found among the entire 44 moths. Gravid females totaled 7.

GENUS *Alabama* GROTE

Alabama argillacea Hbn. The Cotton Leafworm.

The larva of this moth, in addition to being known as the cotton leafworm, is also called the cotton army worm. It defoliates cotton and is an important pest upon that plant in the Southern States. The invasion of the northern part of the United States and Canada by the moths is of frequent occurrence during September and October. The moth is known to puncture thin-skinned fruits and especially grapes during its northern dispersion. In the extreme southern part of the United States five or six generations are said to occur during the summer months. The insect is unable to survive the winter, however, north of the tropics.

Only two specimens of *A. argillacea* were captured in 1933, and none in the two previous years. On September 21, 1934, however, and again on the 28th a heavy flight of this moth was observed. During the two nights, 149 moths were secured. A total of 156 individuals was captured in 1933 and 1934. Flights in all years came in late September or early October.

About half of the captures (75 in number) were females. Most of the females were gravid.

FAMILY NOTODONTIDAE

The moths of this family are as a rule of moderate size and in general appearance resemble the noctuids. Members of the two families, however, can be separated readily on characters present in the wing veins. The bodies of the notodonids frequently are stout and clothed with long, dense hairs. The fore wings are strong and in a number of species have a backward projecting lobe on the inner margin. The presence of these lobes on the wings of the adults and the occurrence of strikingly paired processes on some of the segments of the body of the larvae, in all probability, have suggested the common name of Prominents for this group. A number of species assume economic importance because of their habit of defoliating shrubs and trees.

Although 24 species of the family Notodonidae were obtained during the years 1931 to 1934, the total number of moths secured was moderate. Only a few species were abundant. In fact, each of

19 members of the group are represented by less than 10 specimens. Females were rare.

Genus *Ichthyura* Hübner

Ichthyura apicalis Wlk.

The larva feeds upon poplar. This species has a number of varieties or forms. The moth in its different variations is found throughout the United States, according to Packard (1895, pp. 129-130).

I. apicalis was captured in small numbers in 1932, 1933, and 1934. The period of flight was observed to occur in June and July. In 1933 and 1934 straggling numbers were taken in July at the end of the period of activity. The complete captures consisted of 41 males and 1 female.

Ichthyura albosigma Fitch.

This moth was secured in nearly the same abundance as *I. apicalis*. It has a distribution similar to that of *I. apicalis*. The larva feeds upon poplar and willow.

Specimens of this species were taken from the end of May until August 20 without any time of marked abundance. The limited number of captures each year (24 was the highest in one year) does not make it possible to determine whether the insect is single or double brooded. Beutenmüller (1898, p. 411) states that *I. albosigma* is double brooded in the vicinity of New York City. He has reported that the moths appear in May and again in July and August.

Genus *Datana* Walker

Datana ministra Dru. The Yellow-necked Apple Worm.

Houser (1918, p. 230) lists the following hosts: apple, pear, cherry, quince, linden, walnut, hickory, white oak, black oak, chestnut, beech, witch-hazel, hornbeam, birch, locust, sumac, sourwood, and sorrel tree. Artificial control methods are occasionally required to prevent defoliation of the trees attacked.

The distribution of *D. ministra* extends from Canada to Virginia and westward to Kansas, Wisconsin, and California, according to Packard (1895, p. 108).

Between 10 and 25 moths were obtained each year. The period of flight began June 15 and continued through July. (Figure 24.) In 1932 a few moths were secured in August, while in 1931 and in 1934, the flight was completed prior to the end of July.

All of the 63 specimens captured were males. In New York, Forbes (1926, p. 614) reports that the moths are on the wing from June to August. Packard (op. cit.) states that the species is single brooded throughout its range.

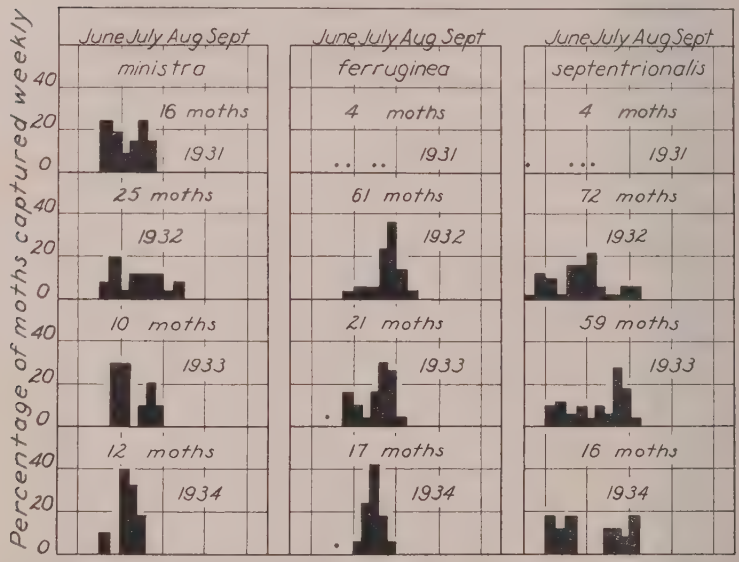

FIG. 24. A graphic summary of records of moths of the species *Datana ministra* Dru., *Lophodonta ferruginea* Pack., and *Gluphisia septentrionalis* Colk. captured at lights during a period of four years.

D. ministra has a period of moth activity between June 15 and early August. Limitation to one brood is evident.

Adults of *L. ferruginea* are active from early June until the middle of August. The one brood is most abundant during July.

G. septentrionalis is in flight from May to early August. The data are not clear but are suggestive of two overlapping broods.

GENUS *Pheosia* HÜBNER

Pheosia dimidiata H. & S.

The larva feeds upon poplar and willow. This insect is

distributed across the northern United States and it also is found at higher altitudes southward.

P. dimidiata was taken in largest numbers from July 20 to August 28. A well-marked late summer brood was observed each year in July and August. A few specimens captured in late May and early June during 1931 and 1932 seem to indicate that a partial early brood develops in favorable years.

Beutenmüller (1898, p. 414) finds that it is double brooded in New York. The moths appeared in May and June, and again in July and August.

The total moths captured were 64 males and 2 females.

Genus *Lophodonta* Packard

Lophodonta ferruginea Packard

Birch is the food-plant of this insect in its larval stage. The moth is reported from New England, New York, North Carolina, and Colorado, according to Packard (1895, p. 151).

L. ferruginea was the second most common Notodontid moth, and a few over 100 individuals were taken. (Figure 24.)

Over three-fourths of all specimens were captured in July. However, the entire period of flight extended from June 12 to August 14 when all four years are considered. A few straggling moths were observed in June, before the height of activity, and again in early August. Limitation to a single brood under Maine conditions seems evident.

Packard (1895, p. 151) in summarizing the observations of Dyar states that it is double brooded at Plattsburg, New York, but single brooded in the Adirondacks.

Only 7 females were found among the total captures of 103 moths.

Genus *Gluphisia* Boisduval

Glusphisia septentrionis Walker

Packard (1895, p. 93) reports that the larvae have been found feeding upon, or have been reared upon, poplar, yellow birch, balm of gilead, willow, and sweet gum.

G. septentrionis is generally distributed throughout the United States, according to Dyar (1902, p. 257). Packard (op. cit.) found it most common in its northern range.

This moth was the most abundant of all species in the Family Notodontidae at Orono. In 1932, it was particularly common and 72 specimens came to the light-trap.

G. septentrionis was taken over a longer period of time than any other species of the family. During the two years of its greatest abundance, flight extended from late May or early June until August 4. Figure 24 shows the captures in a graphic summary.

To the writer, the data obtained are not conclusive in showing the presence of either one extended brood or two overlapping broods.

For New York, Forbes (1926, p. 617) seems to find evidence of two broods, one in March and April, the other from June to August. Packard (op. cit.) quoted other investigators to the effect that it has two broods.

The total captures consisted of 151 moths, but only 2 of them were females.

FAMILY THYATIRIDAE

This is a small family in which the species resemble the Noctuidae or Notodontidae in their general appearance. Five species are reported from New York by Forbes (1923a, p. 686-688). The two moths listed below were the only members of this family taken at lights by the writer.

GENUS *Habrosyne* HÜBNER

Habrosyne scripta Gosse

The larva feeds upon blackberry, thimbleberry, and other Rosaceae, according to Forbes (1923a, p. 686).

This moth has been taken extensively in Canada and southward in the Atlantic States to New Jersey.

H. scripta was not secured in 1931, but during the other three years was fairly common. The moths came to the light-trap over a period of 10 weeks in June, July, and early August. Two broods are evident. The moths of the first brood appeared between June 17 and July 9 in 1932. During 1933 and 1934 the first brood was confined to June but flight began earlier in the season than in 1931. The members of the second brood in

all three years were in evidence rather uniformly between July 10 and August 16.

That two broods develop in New York is the opinion of Forbes (1926, p. 588). There one brood appears in June and the other in August.

The sexes were fairly equally divided in the total captures. Females numbered 42 specimens and males 65. During 1934, females were taken in greater numbers than males, namely, 32 and 22 respectively. Nearly all females examined were gravid. The eggs were usually not fully developed.

Genus *Pseudothyatira* Grote

Pseudothyatira cymatophoroides var. *expultrix* Grote.

The host plants of the larva are reported by Forbes (1923a, p. 687) to be oak and thimbleberry.

This species is found throughout the eastern part of the United States from New England to Virginia.

During 1934, the year of its greatest abundance, 33 specimens of this insect were taken. The season of flight began regularly from June 18 to 24 and extended until August 3 to 7. The majority of all captures each year were taken in July. Limitation to a single brood is clearly evident. (Figure 25.)

The males far exceeded the females of *P. cymatophoroides expultrix* at the light-trap. The males totaled 67 specimens and the females 8 for the three years in which this moth was captured.

Family Lymantridae

This family, although composed of relatively few species, is of great importance economically. The moths are of medium size, and the females in a number of species are wingless. The legs of both sexes are thickly clothed with hairs and, in addition, the female is usually provided with a tuft of anal hairs which are deposited as a covering for the egg masses. Six species of the family were secured at lights.

The larvae are thickly covered with hairs. Frequently, these hairs are arranged in bunches or tussocks which project outward from the body. The caterpillars, as a rule, feed upon the foliage of trees.

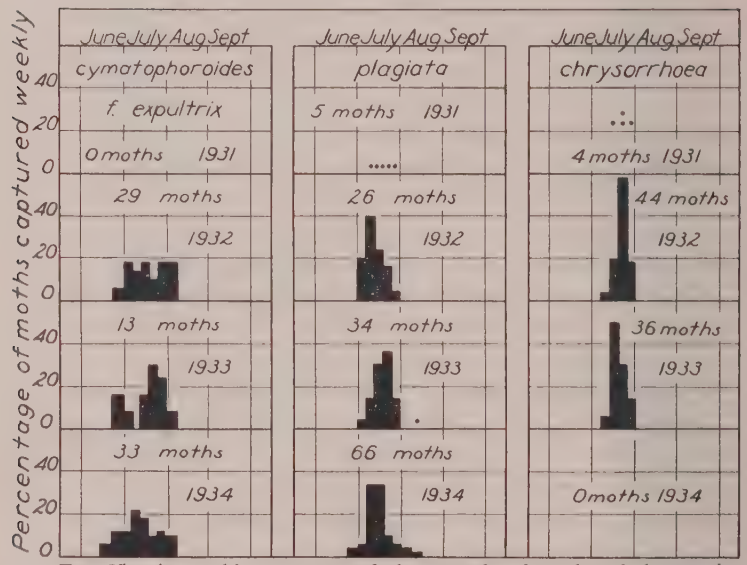

FIG. 25. A graphic summary of the records of moths of the species *Pseudothyatira cymatophoroides* var. *expultrix* Grote, *Olene plagiata* Wlk., and *Euproctis chrysorrhoea* L. captured at lights during a period of four years.

P. cymatophoroides variety *expultrix* has one brood of moths with the period of activity extending from mid-June until early August.

O. plagiata has one brood with the moths active in flight from late June to early August.

The flight of *E. chrysorrhoea* takes place in July at Orono.

GENUS *Hemerocampa* DYAR

Hemerocampa leucostigma S. & A. White-marked Tussock Moth.

The white-marked tussock moth caterpillars feed widely upon trees and shrubs. Houser (1918, pp. 209-210) gives an extensive list of 38 food plants, which include spruce and fir. Injury is often extensive unless artificial control methods are applied.

This insect is found over the entire eastern half of the United States, including the States of the Mississippi Valley. Along the Atlantic seaboard it ranges from Nova Scotia to Florida.

Although a few moths of *H. leucostigma* were taken each year, it was not common except in 1932 when 34 specimens

were obtained. The period of flight took place during August and September. In 1932, the first moth was secured on August 2 and the last one on September 14. During other years, all individuals were taken within the limits of these dates. Limitation to a single brood is clearly shown by these data.

Forbes (1926, p. 617) reports that the flight season in New York extends from the end of July to early October. In Ohio, Houser (op. cit.) finds that there are two full broods, and in the southern part of the state at least a partial third. Howard (1899, p. 19) states that in the vicinity of Washington, D. C., there are two and probably three annual generations.

Since the female of this species is wingless, all specimens taken at light-traps were males. A total of 56 were captured.

Genus *Olene* Hübner

Olene plagiata Wlk.

Forbes (1926, p. 618) reports that the larva feeds upon pine. This is not in agreement with Beutenmüller (1898, p. 386) who states that the food-plant is oak. At Orono, within the vicinity of the light-traps, oak trees are scarce, while pines are common.

O. plagiata is found in the eastern part of the United States. Beutenmüller (op. cit.) states that it is rare in the vicinity of New York City.

Specimens of this moth were taken each year. In 1934, the species was abundant and 66 moths were captured. With few exceptions, all individuals came to lights during July. (Figure 25.) The data obtained show a period of activity beginning in late June or early July and extending until early August.

There were 109 males and 22 females among the moths secured.

Genus *Porthetria* Hübner

Porthetria dispar Linn. The Gypsy Moth.

This well-known insect is not common at Orono. During 1932 and 1933, a combined total of 8 males were captured at the

light-traps. All specimens were taken between July 18 and August 1.

GENUS *Euproctis* HÜBNER

Euproctis chrysorrhoea Linn. The Brown-tail Moth.

The correct scientific name of this insect is *Nygmia phaeorrhoea* Donovan. (Barnes and Benjamin, 1926, p. 213.) The name *E. chrysorrhoea* has been in use over a period of many years, therefore it was retained in this study.

Fernald and Kirkland (1903, p. 57) report a list of nearly eighty species of trees and plants on which the caterpillars are known to feed. Pear, apple, and stone-fruit trees are favored by the insect. Perhaps oaks, maples, and elms are the shade and forest trees most injured. Conifers are not attacked.

This introduced pest from Europe is reported by Burgess (1930, p. 24) to be confined on the American continent to the New England States and Nova Scotia. In Maine the brown tail moth has never been seriously abundant except in the southwestern part of the state.

Moths were captured each year except in 1934. The extreme low temperatures of the winter of 1933-1934 killed large numbers of the over-wintering larvae, according to observations made by the writer. This doubtless accounts for no moths being taken in 1934.

All individuals were secured in July. (Figure 25.) No moths were captured prior to July 10 or later than July 27. Britton (1914, p. 18) reports that in Connecticut the moths fly during the first half of July.

GENUS *Stilpnotia*

Stilpnotia salicis Linn. The Satin Moth.

The food-plants of the larva are reported by Burgess and Crossman (1927, pp. 11-12) to be poplars and willows.

This insect is widely distributed throughout Europe and Asia. In North America, it occurs in the New England States and also in British Columbia and the State of Washington.

During two years of the project, the satin moth was epidemic. *S. salicis* spread rapidly throughout southern and cen-

tral Maine during 1926 to 1930, but the insect was not common at Orono until 1931 and 1932. Heavy feeding by the caterpillars on host trees was common in the vicinity of the light-traps during this time. A group of poplars on the University of Maine campus were almost completely defoliated. An extreme increase in the number of moths captured was noted between 1931 and 1932. In the former year, 83 moths were taken and in the latter 380. During 1933, the insect was also captured in large numbers (255 moths). By 1934, parasites, predators, and also possibly the low winter temperatures, became effective checks, and only 21 moths were secured.

The moths of *S. salicis* were on the wing uniformly during

FIG. 26. A graphic summary of records of moths of the species *Stilpnotia salicis* L., *Malacosoma americana* Fabr., and *M. disstria* Hbn. captured at lights during a period of four years.

The flight of *S. salicis* begins in late June and extends to the middle of August. Maximum activity takes place between July 7 and 27.

M. americana has a flight confined largely to July. The climax of abundance usually comes about July 10.

The flight of *M. disstria* is very similar to that of *M. americana*. However, straggling numbers of moths appear in August in the case of *M. disstria* but not of *M. americana*.

July. (Figure 26.) The earliest moth captured was taken on June 26 and the last on August 14. Heavy flights were observed only during the second, third, and fourth weeks of July.

Females comprised 23 per cent of all specimens taken. The total captures were 567 males and 172 females. All except two of the females were gravid. The eggs, with few exceptions, were found to be fully developed and ready for deposition.

FAMILY LASIOCAMPIDAE

This family is composed of relatively few species, but some of its members are common and at times important pests. The moths are of medium size, with stout bodies covered with hairs. Both sexes have pectinate antennae, and have a large expanded humeral angle of the hind wings, instead of a frenulum. The larvae feed upon the leaves of trees. The light-trap captures represented three species of the group.

GENUS *Malacosoma* HÜBNER

Malacosoma americana Fabricius. The Eastern Tent-caterpillar.

The preferred food-plants of the caterpillars are wild cherry and apple. When the caterpillars are excessively abundant, apple trees are completely stripped of their foliage if no artificial control methods are applied. The larvae also attack, less frequently, plum, peach, thorn, pear, rose, and other members of the Rosaceae. More rarely, and under special conditions of acute outbreaks, defoliation may take place on beech, witch-hazel, elm, willow, oak, and poplar, according to Quaintance (1921, p. 5).

M. americana occurs as a common insect in the United States from Canada south to Florida and westward to the Rocky Mountains.

Between 75 and 152 moths were captured each year. No marked up or down trend in abundance was observed with the different years. Headlee (1934, p. 2) recently reports that there are cycles of abundance in New Jersey at approximately ten-year intervals.

The period of activity at lights was noted to extend from the last days of June to the end of July or early August. (Figure

26.) The peak of captures came at practically the same date each year. In 1931 the most specimens were taken on the night of July 11, in 1932 on July 10, in 1933 on July 10, and in 1934 on July 14. Slingerland and Crosby (1915, p. 116) have found that the majority of the moths in New York emerge during the last week of June and the first week of July. Beutenmüller (1898, p. 443) states that the eggs are laid late in June and early in July.

The complete captures comprised 361 males and 95 females. The majority of the females were found to possess few or no eggs. Among all moths of this sex only 12 were taken prior to their oviposition.

Malacosoma disstria Hubner. The Forest Tent-caterpillar.

The food plants of this caterpillar include almost all deciduous trees. Swaine (1918, p. 2) reports that it prefers poplar, birch, elm, oak, and maple. He observed an outbreak in 1912 in which many square miles of poplar and birch in Canada were completely defoliated. In Maine, Peirson (1927, p. 39) states that thousands of acres of woodlands, particularly white birch and poplar, were defoliated in 1922 and 1923. During 1933 and 1934, the writer observed extensive forested areas in Central Maine on which foliage was stripped from the trees. Serious damage in any locality is limited to periods of two or three consecutive years which are followed by intervals during which the insect is relatively scarce.

M. disstria is found in all parts of the United States, in Canada, and in Mexico. Outbreaks have been observed most frequently in New York, New England, and Canada.

M. disstria was the second most abundant insect during this study. In 1931, the low number of 59 moths came to the light-trap. By 1932, this number increased to 276 specimens. During the year 1933, on two different dates, unusually heavy flights were observed. On the night of July 10, 1,321 moths were taken and again on July 12, the huge number of 3,306 moths was captured. In 1934 the complete captures comprised 3,045 individuals, 2,700 of which were taken during 7 nights.

The period of flight at lights is very similar to that of *M. americana*. (Figure 26.) The first moths of *M. disstria* appeared a few days later than *M. americana*. Both species were

abundant on the same nights in July during all four years. *M. disstria* was captured in straggling numbers throughout August in 1933 and during the first two weeks of August in 1932 and 1934.

Forbes (1926, p. 588) states that in New York the moths of this species appear later than those of *M. americana.*

About 30 per cent of all moths taken were females. The totals were 2,949 females and 5,535 males. Approximately 51 per cent of the females were gravid when captured. The eggs were generally ready for oviposition.

FAMILY DREPANIDAE

The drepanid moths resemble the Geometridae, with their broad wings and slender bodies. The apex of the forewing is generally falcate. The moths are small or moderate in size.

The family is a small one, and is represented by two species in this study, *Drepana arcuata* and *D. bilineata.*

GENUS *Drepana* SCHRANCK

Drepana arcuata Wlk.

The larva feeds upon birch and alder, according to Forbes (1923a, p. 690). Beutenmüller (1898, p. 389) reports that the larva lives singly on the upper surface of a leaf, under a silken web, slightly drawing the leaf together.

The distribution given by Forbes (op. cit.) is Pennsylvania to Indiana and northward.

D. arcuata was taken each year and was abundant during 1932 and 1933. The data secured from the captures indicate two broods. (Figure 27.) The first brood was observed in late May and June, while the moths of the second brood made their appearance after the middle of July and continued on the wing until August 15 or later.

Forbes (op. cit.) has found two broods in New York, one in May and June, and the other in August.

Females at lights were rare, as only 4 were captured among 176 individuals.

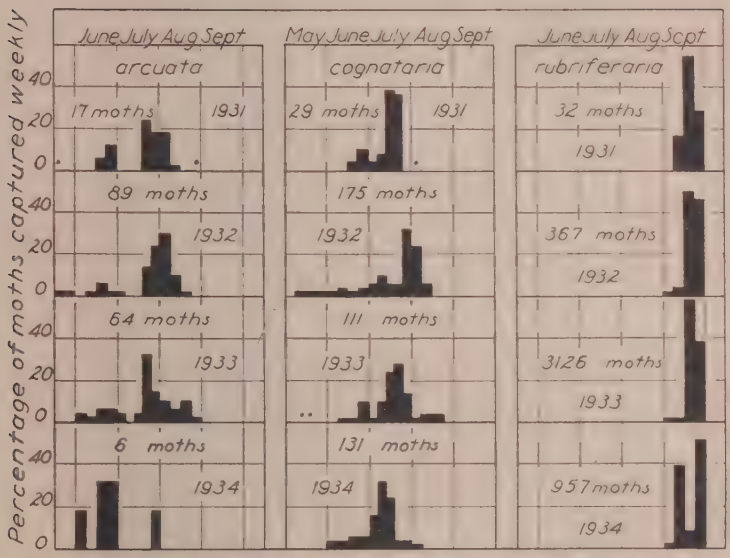

FIG. 27. A graphic summary of records of moths of the species *Drepana arcuata* Wlk., *Lycia cognataria* Gn., and *Cingilia rubriferaria* Swett. captured at lights during a period of four years.

D. arcuata has two broods with a period of maximum abundance in June and another in late July or early August.

Although *L. cognataria* has an extended period of flight from May to August, the species is considered to have only one generation during the year.

C. rubriferaria has a single brood of moths with flight taking place in September.

FAMILY GEOMETRIDAE

The larvae of the family Geometridae are known as loopers, spanworms, and measuring worms. The larvae in walking bring the hind end of the body up as close as possible to the front end, the body thus forming a loop. This peculiar manner of locomotion is characteristic and is correlated with a reduction in number of prolegs.

The moths are usually of medium or small size, but rarely are very large. The wings are broad and frequently delicate, and the abdomen is slender. The geometrids inhabit woodlands more commonly than meadows and pastures. The family is a large one composed of several hundred species. Twenty-seven species were re-

corded at lights during this study. Only 8 of the species were captured to the extent of 50 or more individuals.

GENUS *Nepytia* HULST

Nepytia canosaria Wlk. (*semiclusaria* auct.)

The larva feeds upon fir, pine, spruce, and tamarack, according to Smith (1899, p. 446).

This insect ranges throughout the northeastern United States and in Canada.

The moths are on the wing during September. Greater numbers of the insect were taken between the middle and end of the month than earlier. Forbes (1923b, p. 177) reported this species as having one brood in September at Ithaca. There were 12 females among the total of 65 moths. The eggs were matured and abundant in each captured female.

GENUS *Lycia* HÜBNER (*Amphidasis* TREITSCHKE)

Lycia cognataria Gn. The Salt and Pepper Currant Moth.

The larva is a general feeder on trees and shrubs. *L. cognataria* is a common insect throughout the eastern United States.

L. cognataria was the second most abundant geometrid. Over 100 specimens were obtained during each of three years. The moths appeared over an extended period from May to August. (Figure 27.) A single brood with a climax of abundance in August is suggested by the data obtained at the light-trap. In New York, Forbes (1926, p. 603) finds the moths are taken from May to August.

In the total captures of 446 moths, 11 females were found, of which 7 were gravid.

GENUS *Cingilia* WALKER

Cingilia rubiferaria Swett

Little is known concerning this insect. A closely related geometrid *C. catenaria* has been reported by Phipps (1930, p. 138-139) as feeding on a wide range of plants including blueberry. Forbes (1926, p. 604) reports *C. rubiferaria* as having been taken at Peru, New York, on September 15 and 16, in 1917.

C. rubiferaria was the most common geometrid. A heavy flight was observed in 1933 and more than 2,800 moths were taken on the single night of September 21. Each year the moths were on the wing only in September. (Figure 27.) The climax of the flight was observed to occur generally toward the end of the month.

The proportion of females to males was small. The total captures consisted of 4,482 individuals and of these only 72 were females. The eggs of the dissected moths were immature.

Genus *Campaea* Lamarck

Campaea praegrandaria Gn.

The larva of this species feeds upon white birch and willow. In distribution this moth is found in Canada and in the northern United States from Maine to the State of Washington.

In 1932, *C. praegrandaria* was fairly common and 46 moths were taken. Less than 20 specimens were captured in any other year. There are two broods, but the first brood in June and early July is reduced in numbers. The flight of the second brood took place at the end of August and in early September. In 1934, contrary to the other years, the moths of the first generation were more abundant than those of the second.

In New York, Forbes (1926, p. 605) reports two broods at approximately the same periods as given above.

Females numbered 33 moths and males 51 for *C. praegrandaria*. All of the females were gravid and the eggs were found to be fully developed.

Genus *Ennomos* Treitschke

Ennomos magnarius Gn.

The food plants of the larva consist of maple, birch, chestnut, elm, linden, and other trees.

The moth occurs in Europe, in Canada, and throughout the northern United States.

E. magnarius was captured in limited numbers each year. The data secured by light-traps indicate clearly limitation to one brood. The moths appeared during August, September, and October. Most of the specimens were taken in September.

Only 1 female was obtained among the total captures of 83 moths.

GENUS *Xanthotype* WARREN

Xanthotype crocataria Fabr.

The species *crocataria* of Fabricus has recently been separated into *X. sospeta* and *X. urticaria* Sw. A number of the moths in this genus were determined by W. T. M. Forbes as *X. sospeta* Dru.

The larva feeds upon strawberry and currant, according to Packard (1876, p. 475).

The moth ranges throughout the United States east of the Mississippi River and also has been found in Iowa.

This geometrid totaled 47 moths in 1934. It was not so common in 1932 and 1933. No moths were captured in 1931. A single brood of moths, with a period of flight which began in late June or early July and extended to August 8, was found to be characteristic.

Under New York conditions, Forbes (1923b, p. 179) observed two broods, one in June and the other in August.

All individuals taken were males.

GENUS *Pero* HERRICK-SCHNAEFFER

Pero honestarius Wlk.

Pero honestarius is found throughout the entire United States. It also is distributed in Canada.

P. honestarius was taken each year in small numbers. A period of flight from the end of May or early June until the middle of July was characteristic of the species. The climax of activity generally came in late June or early July.

Forbes (1923b, p. 179) observed two broods in New York. He states that the first brood was most abundant and came at the end of May and that a very weak second brood occurred in August.

There were 3 females and 52 males among the specimens of *P. honestarius*.

Genus *Sabulodes* Guenée

Sabulodes transversata Drury

The larva feeds upon oak, maple, currant and other trees and shrubs.

This insect is widely distributed in the United States from Maine to Georgia and westward to Missouri. It is also found in Canada.

S. transversata was relatively uncommon except in 1934. All specimens, during the first three years, were taken in August and September. (Figure 28.) In 1934, the period of flight extended from the last week of July until early October with peaks of abundance in early August and in October. During that year, 62 moths were captured.

At Ithaca, New York, Forbes (1923b, p. 179) has found that this species was on the wing from mid-July to early October. He also states (1926, p. 609) that two broods occur in New York.

Among the total of 93 specimens taken, 5 were females.

Family Eucleidae

This family was formerly known as the Limacoididae. The larvae are termed slug-caterpillars. Some species possess venomous setae.

The moths are small or medium in size with stout bodies. Less than 50 species are known in all of North America. Only one representative of this family was taken, namely, *Eucles delphinii*.

Genus *Euclea* Hübner

Euclea delphinii Bdv. The Spiny Oak Slug.

This slug-caterpillar feeds upon various trees and shrubs including oak, willow, and pear.

The moth has been taken throughout the Atlantic States. Only 7 specimens of *E. delphinii* were captured. These came to lights at the end of June and during the first two weeks of July. All specimens were males.

FAMILY PYRALIDAE

The Pyralids are commonly classified among the Microlepidoptera, since a large proportion of the species are medium or small in size. The three species recorded in this study include the larger members of the group. Many other pyralids were captured in the light-traps but were discarded because their small size made it impracticable to prepare these moths for identification, under the conditions of this study.

GENUS *Pantographa* LEDERER

Pantographa limata G. & R.

The food plant of the caterpillar is linden. In its habits the larva is a leaf-roller, according to Forbes (1923a, p. 548).

This moth ranges from Maine to Virginia and westward to Minnesota. It is also found in Mexico and South America.

P. limata was not abundant. A few moths were taken during 1932, 1933, and 1934. From the data obtained, a period of flight beginning about July 10 and lasting until near August 15 seems characteristic. The complete captures were made up of 26 males and 3 females.

GENUS *Nomophila* HÜBNER

Nomophila noctuella Schiff. The Celery Stalk Worm.

The larva feeds widely on low growing plants and has been recorded on celery, grass, clover, and *Polygonum*.

In its distribution, this species is cosmopolitan. It occurs in Europe, North Africa, India, and Brazil, and in the eastern and western parts of the United States.

N. noctuella was taken in greater numbers than any other insect during this study. Excessive abundance was noted particularly in 1933 when 10,496 moths were captured. The season of 1934, with a total of but 61 specimens, contrasted strongly in abundance with 1933. In 1933, moths were taken each week from the middle of May until early October. Generally, *N. noctuella* was most abundant during July and August. (Figure 28.) The data, however, do not clearly indicate the periods of the separate broods.

Field observations in New England made by Ellis (1925, p. 787) indicate there are two complete generations. Felt (1893, p. 131) has reported that in New York there seem to be three broods. The extended period of flight at Orono would allow for two full broods to take place.

Approximately 40 per cent of all specimens captured were females. A large proportion of the females were gravid. The stage of development of the eggs varied from partially to fully mature.

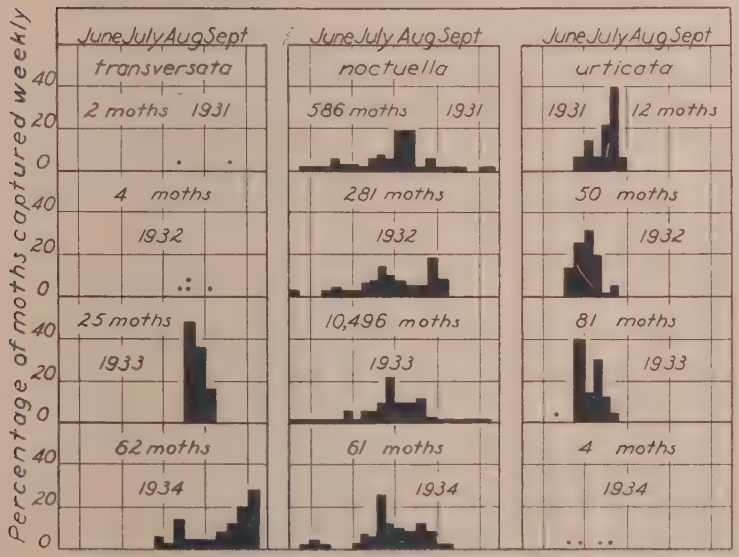

FIG. 28. A graphic summary of records of moths of the species *Sabulodes transversata* Drury, *Nomophila noctuella* Schiff., and *Eurrhypara urticata* L., captured at lights during a period of four years.

S. transversata has one brood of moths with a flight between the end of July and early October.

N. noctuella has an extended period of flight from early May to October. Two overlapping broods of moths seem fairly evident at Orono.

E. urticata has a flight from early June until late July. One brood is well defined.

GENUS *Eurrhypara* HÜBNER

Eurrhypara urticata Linn.

The larva feeds upon nettles.

This pyralid is apparently an introduced species from

Europe. It was first collected at MacNab's Island and at Truro, Nova Scotia. (Forbes, 1923a, p. 581). In 1923, Holland (1924, p. 294) reported that it was taken at Freedom and Machias, Maine. A few years later Johnson (1927, p. 176) stated that specimens had been obtained at Salisbury Cove, Mt. Desert, Maine, in August, 1926. It is widely distributed in Europe and Asia.

That *E. urticata* is well established at Orono is indicated by the fact that 147 specimens were taken during this study. In 1933 alone, a total of 81 moths were captured. Its flight during each season is shown in Figure 28. The moths were on the wing for a period of about seven weeks each summer. Flight began generally during the last half of June and ended near August first.

The total captures consisted of 119 males and 28 females. There were 22 gravid moths. The eggs of the dissected females appeared to be mature.

OCCURRENCE OF SPECIES BY YEARLY INTERVALS

The total number of species represented by the moths captured during this project was 349. Additions to the list of species were made each year. In 1931 the collections included 160 species; in 1932, 214 species; in 1933, 260 species; and in 1934, 294 species. That the composition of the number of species varied from year to year is indicated in the following table:

TABLE 4

Occurrence of Species by Yearly Intervals from 1931 to 1934

Years of occurrence	Number of species concerned
Species captured during each of the 4 years	132
Species captured during 3 of the 4 years	56
Species captured during 2 of the 4 years	83
Species captured only in 1931	7
Species captured only in 1932	9
Species captured only in 1933	23
Species captured only in 1934	39

To some extent, the apparent difference in numbers of species between the several years was due to increased familiarity and effi-

ciency in handling material during the latter years of the study. No doubt certain species were represented during 1931 and 1932 among a small number of specimens that were discarded without being identified. The writer is of the opinion, however, that the list of species could be substantially lengthened, if the study were continued over a longer period of years.

OCCURRENCE OF SPECIES BY WEEKLY INTERVALS THROUGHOUT THE SEASON OF FLIGHT

That the abundance of insects is greatest during the warmest periods of the summer is a common observation in other regions similar to Maine. Also, that a period of adult activity for most species of Lepidoptera takes place between May and October is like-

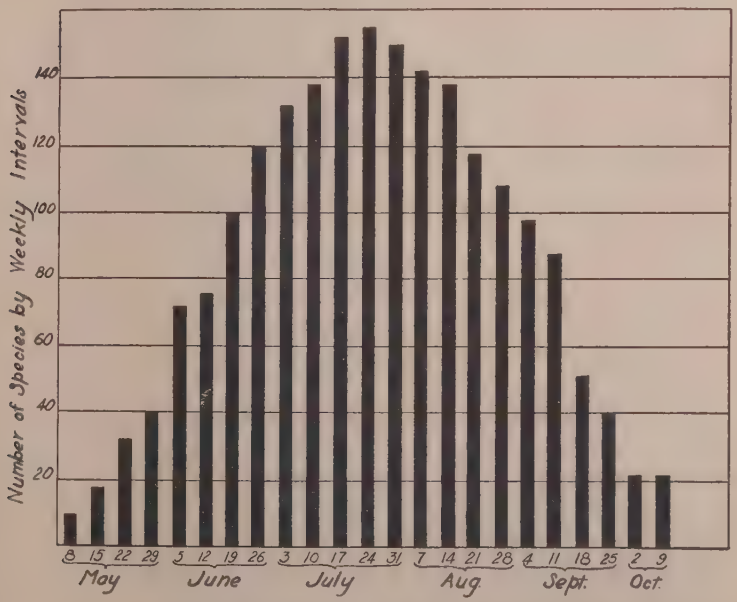

FIG. 29. The average number of species of moths that came weekly to the light-traps at Orono, Maine, during 1931-34 combined. The number increased rapidly from early May until the middle of July. During August, September, and early October the number of species became fewer as each week passed.

wise obvious. At what date the maximum number of species is attained and how slowly or rapidly new species appear during the season are factors not so well known.

When the weekly periods of capture for all species are tabulated for all four years, a peak is found to take place in July. (Figure 29.) The number of species was observed to increase rapidly from early May to mid-July and then decrease to a low figure again in October. A period of four weeks from mid-July to early August covered the interval in which as many as 140 species were taken at lights. This peak of high numbers of species in July was in strong contrast with the low numbers of only 8 species that were captured in early May and with the 22 species found to occur in early October.

In Table 5 is shown the average number of species captured during each night for the several months of the season and for the different years. It indicates, rather definitely, the incidence of more species in July than at other periods. Table 3 also shows that the average catch of moths consisted of about 6 species each time the light-trap was operated in May. During June, the number of species was approximately doubled to 12 or more. In July, as high as 35 species were captured on a typical night. After the height of abundance in July, the total number of species obtained each night steadily decreased during August, September, and early October.

TABLE 5

Monthly Averages of the Number of Species Captured Each Night That the Traps Were Operated

Month	1931	1932	1933	1934
May	6.1	8.7	5.9	6.4
June	8.9	15.0	19.0	31.3
July	15.1	4.5	33.4	50.2
August	10.8	34.1	31.6	35.6
September	9.2	13.7	16.6	27.1
October	6.5	4.0	3.0	6.0

When weather conditions were highly favorable for flight, frequently a surprisingly large number of species were represented by the moths captured during a single night. When the data are compared, it is seen that the number of species taken during a single favorable night in July, for two years out of the four, exceeded that of any other month. Table 6 shows these relationships:

TABLE 6

The Number of Species Captured During a Single Favorable Night During Each Month

Month	1931	1932	1933	1934	Average no. of species for the 4 years
May	8	14	12	11	8.7
June	23	39	60	49	42.7
July	31	58	70	88	61.7
August	24	70	66	57	54.2
September	33	41	26	60	40.0
October	15	5	3	6	7.2

Table 6 also shows that 88 was the largest number of species to be taken during a single night throughout the course of the study. This interesting record was observed on July 15, 1934, and consisted of 712 individual specimens.

ABUNDANCE OF INDIVIDUALS BY YEARLY AND MONTHLY INTERVALS

A wide variation in the number of individual specimens was observed from month to month and between the different years. The year of 1933 with nearly 30,000 moths was unusually high in the number of specimens captured. The captures for 1932 and 1934 were about equal, with specimens numbering approximately 10,000 and 12,000 respectively. The low total for 1931 with 3,000 moths was evidently due at least partly to the type of light-trap used. The other three years were on a comparable basis.

Since, generally, more species were captured during July than at any other time, it would be logical to expect the largest number of individuals to be taken during approximately that period for any year. Such was the case, and each year, except in 1932, July specimens outnumbered those of any other month. In many respects the variation in the number of individuals captured during the season of flight nearly paralleled the variation in the number of species represented. In May, however, except for 1931, more moths were captured than in October, although fewer species frequented lights in May than in October. Each year, July and August captures exceeded by far the combined captures of the rest of the season. Specimens obtained in June and again in September were intermediate

in abundance between the high numbers captured in July and the low numbers taken in May and October. These data are presented in Table 7.

TABLE 7

Numbers of Moths Captured During Each Month from 1931 to 1934

Month	1931	1932	1933	1934	Average no. of moths for the month
May	80	116	808	129	258.2
June	562	1,192	2,454	1,351	1,389.7
July	1,075	3,954	14,509	6,327	6,466.2
August	920	4,467	7,850	2,677	3,978.5
September	323	716	4,357	2,080	1,616.5
October	113	26	18	27	46.0
Total for the year	3,073	10,471	29,996	12,591	
Grand total for the 4 years					56,131

THE PROPORTION OF THE SEXES

Of the total number of individuals captured during the four years, 22.5 per cent were females and 77.5 per cent were males. The percentage of females varied between the different years as much as 10 per cent. For example, during 1933, the females comprised 28 per cent of all captures, and in 1932, 17.2 per cent. The percentages of these two years for the females represent the maximum and minimum obtained during the project.

Observations show that the proportion of the sexes varied widely among the species of the Noctuidae and generally among other families also. A few examples are taken from the Noctuids to indicate the extremes that occur among species. When all the data were tabulated, it was found that the females made up 17 per cent of all moths of this family. The tables below present species arranged in two groups to show that the percentage of females was frequently either above or below the average. The data selected in Tables 8 and 9 are taken only from those species in which large numbers of individuals were captured.

Detailed information upon the ratio of males to females for each species may be readily determined from the data presented

TABLE 8

Species of Noctuids in Which the Percentage of Females Captured Was Low

Species	Total number of moths captured	Percentage female	Percentage of females in a gravid condition
Feltia venerabilis	775	7	92
Polia atlantica	234	11	96
Polia renigera	496	11	98
Nephelodes minians	531	2	100
Ceramica picta	196	6	100
Gortyna micacea	597	3	100
Autographa falcigera	644	6	49

TABLE 9

Species of Noctuids in Which the Percentage of Females Captured Was High

Species	Total number of moths captured	Percentage female	Percentage of females in a gravid condition
Orthosia hibisci	588	36	94
Cirphis unipuncta	947	45	81
Septis arctica	233	77	93
Trachea finitima	119	82	93
Apamea velata	712	49	90

under the section entitled "List of the Species and Summary of the Catch of Moths at Lights, Orono, Maine, 1931-1934, Inclusive." Also, data are brought forward upon the percentage of females and the percentage of gravid females, in the discussion of those species that were captured in abundance.

Facts from other investigators on the percentage of light captures that consist of females may be found in the following section.

GRAVID FEMALES

The percentage of females that were gravid was high in all species captured in sufficient numbers to fully establish the percentage. Eighty-two per cent of all females were gravid. This calculation is based upon 3,970 individuals taken from all species and

consisting of all the females secured throughout the four years. The percentage of gravid females obtained by the writer was somewhat higher than that reported by other American investigators who have studied the Macrolepidoptera captured at lights. The proportion of females to males, however, is in fairly close agreement with that reported by other investigators.

Slingerland (1902, p. 208) used kerosene lamps as a source of light and found that less than 20 per cent of all Lepidoptera captured were females. He states that in most cases the females had already laid most of their eggs before they were captured at the light-traps.

While working with the variegated cutworm moths, *Lycophotia saucia*, Bensel (1916, p. 303) reported that of a large number of female moths captured at powerful electric arc lights approximately 22 per cent were gravid.

Turner (1918, p. 136) states that females represented 28.5 per cent of a total of 11,222 moths of numerous species captured at an electric light trap. He also found that 58 per cent of the total females were gravid.

INFLUENCE OF TEMPERATURES DURING THE NIGHT UPON THE NUMBER OF MOTHS CAPTURED

A fairly close relationship between temperature and number of moths captured was observed during this project. Only a few moths frequented the lights when the average nightly temperature was as low as 40 to 42 degrees Fahrenheit. Warmer nights, with temperatures approximating 52 to 56 degrees, were marked by medium to occasionally large numbers of moths captured. Often as many as 200 specimens were obtained at these temperatures and during one very favorable night, with a temperature of 56 degrees Fahrenheit, a catch consisting of 1,816 individuals was secured. Other atmospheric conditions were highly favorable on this date, however, and many species were at their climax of flight. Although nights with temperatures above 60 degrees Fahrenheit were comparatively few, they yielded many more moths in the aggregate than did the cooler nights. During seven different nights, while the average nightly temperature was 58 degrees or above, uncommonly large captures of 900 moths or more were obtained.

TABLE 10

Moth Catch and Meteorological Data During Operation of 200 Watt Light—1932

Date	Total No. of Moths	Total No. of Species	Average Temperature in F. for night	Clouds	Moon	Remarks on Condition
June 15	48	25	65	A few, light	Fairly bright	Temp. favorable but moon too bright
" 16	79	28	63	Heavy	Completely overcast	Apparently all conditions favorable
" 17	11	9	52	Heavy with fog	Completely overcast	Dark night but temp. too low
" 18	23	14	50	Clear until 11 P.M.	Bright until 11 P.M.	Cool and moon too bright
" 19	17	13	52	A few, light	Bright most of night	Moon too bright, temp. too low
" 20	64	27	61	Heavy	Completely overcast	Favorable conditions apparent
" 21	29	18	61	Light, fleecy	Bright most of night	Temp. favorable but moon detracts
" 26	38	22	56	A few, light	Fairly bright	Moon detracts
" 27	140	39	52	Heavy	Completely overcast	Dark, humid night, warm till midnight
" 28	35	21	57	None	Bright most of night	Temp. favorable but moon detracts
" 29	86	36	62	Heavy, with rain	Completely overcast	Warm but rain fell most of night
" 30	82	37	57	None	Fairly bright	Moon too bright
July 1	120	42	60	Heavy, with showers	Completely overcast	All conditions apparently favorable
" 5	54	25	56	None	Not bright	Clear night with wind
" 6	177	37	60	None	Not bright	Temperature highly favorable
" 7	185	38	60	None	Not bright	Temperature highly favorable
" 8	106	30	58	Cloudy, foggy	Overcast	Cool after midnight
" 10	306	58	69	Heavy	Completely overcast	Apparently all conditions favorable
" 11	213	35	61	Light	Fairly bright	Temperature favorable
" 14	38	13	58	None	Bright	Moonlight unfavorable
" 16	28	15	55	None	Bright	Moonlight too bright
" 18	83	24	62	Few, light	Bright most of night	Moonlight unfavorable
" 19	148	41	60	Medium heavy	Overcast	More clouds than previous night
" 21	77	24	61	None	Bright	Moon detracts
" 22	208	48	62	Heavy, with rain	Completely overcast	Apparently all conditions favorable
" 23	138	40	60	Heavy, with rain	Completely overcast	Heavy rain part of night

TABLE 11

Moth Catch and Meteorological Data During Operation of 500 Watt Light—1932

Date	Total No. of Moths	Total No. of Species	Average Temperature in F. for night	Clouds	Moon	Remarks on Condition
July 27	587	46	66	Heavy	Completely overcast	Conditions highly favorable
" 29	240	30	61	None	Not bright, small	Not as dark or warm as July 27
Aug. 4	407	48	63	Heavy, with rain	Overcast, a dark night	Apparently favorable conditions
" 6	264	27	63	None	Fairly bright	Not as dark or humid as Aug. 4
" 9	159	33	62	None	Fairly bright	Moonlight unfavorable
" 10	258	46	65	Heavy, with rain	Completely overcast	Conditions favorable
" 13	59	15	59	None	Bright, early moon	Moonlight unfavorable
" 18	100	21	63	Clouds with light rain	Mostly overcast	Strong wind most of night
" 19	128	37	64	Light	Fairly bright	Temperature favorable
" 20	57	20	59	None	Bright, large	Brilliant moon unfavorable
" 22	34	15	51	None	Bright, large	Fairly cool with brilliant moon
" 24	60	18	60	None	Bright moon	Moon detracts
" 26	96	27	68	None	Fairly bright	Temperature highly favorable
" 30	79	33	59	None	Fairly bright	Moonlight unfavorable

TABLE 12

Moth Catch and Meteorological Data During Operation of 1000 Watt Light—1934

Date	Total No. of Moths	Total No. of Species	Average Temperature in F. for night	Clouds	Moon	Remarks on Condition
June 4	142	41	50	Heavy	Completely overcast	Favorable night for early June
" 5	102	39	64	Heavy, with rain	Completely overcast	Rain during most of night
" 13	57	26	63	Clouds and fog	Mostly overcast	Temp. cool after midnight
" 15	103	42	54	Light	Mostly overcast	Favorable conditions
" 20	78	29	55	None	Fairly bright	Not a dark night
" 24	87	30	62	Rain until midnight	Mostly overcast	Rain retarded flight
" 27	78	22	58	None	Bright moon	Moonlight unfavorable
" 29	144	47	66	Heavy	Completely overcast	Favorable conditions for flight
July 2	164	52	60	None	Fairly bright	Warm but moon detracts
" 5	277	51	65	A few, light	None in evening	Favorable conditions in evening
" 9	536	51	57	None	None in evening	Apparently all conditions favorable
" 11	270	53	58	None	None until midnight	Conditions apparently favorable
" 16	286	55	59	None	Small, quarter moon	Conditions apparently favorable
" 18	225	58	60	Clouds until midnight	Small, about quarter moon	Conditions apparently favorable
" 23	57	28	52	None	Fairly bright	Windy and cool
" 25	366	54	54	Heavy	Completely overcast	Highly favorable conditions
" 30	146	46	62	None	Bright in evening	Moonlight unfavorable
Aug. 1	202	57	61	None	Bright in evening	Moonlight unfavorable factor
" 6	155	48	58	None	Bright moon	Brilliant moon and cool
" 8	163	39	61	None	Bright moon	Favorable temp. but moon too bright
" 14	270	56	57	Partly cloudy	Mostly overcast	Favorable conditions most of night
" 16	186	35	50	A few	Fairly bright moon	Temperature apparently too low
" 20	106	32	56	Light, fleecy	Overcast by light clouds	Not a dark night
" 23	95	27	51	None	Full moon, bright	Cool night with brilliant moon
" 27	280	42	57	Cloudy, light rain	Completely overcast	Highly favorable conditions
" 30	16	7	46	None	Bright moon	Cool night with bright moon
Sept. 4	110	27	54	Heavy	Mostly overcast	Wind unfavorable
" 10	296	42	60	Heavy	Completely overcast	Apparently highly favorable conditions
" 27	24	10	55	None	Bright moon	Fairly cool with bright moon
" 30	12	8	48	None	Bright moon	Cool and moon too bright

TABLE 13

Moth Catch and Meteorological Data During Operation of S1 "Sunlamp"—1934

Date	Total No. of Moths	Total No. of Species	Average Temperature in F. for night	Clouds	Moon	Remarks on Condition
June 14	107	41	54	Heavy	Completely overcast	Cool in morning, generally favorable
" 17	125	49	56	None	Not bright, small	Apparently favorable conditions
" 22	108	31	56	Medium heavy	Mostly overcast	Favorable conditions
" 25	39	18	54	Almost a clear sky	Bright moon	Moonlight unfavorable
" 28	129	44	60	Clouds and fog	Mostly overcast	Generally favorable for flight
July 1	238	48	62	Heavy, with rain	Overcast most of night	Highly favorable conditions
" 4	316	49	60	None	Fairly bright	Moonlight detracts somewhat
" 8	1657	65	61	None	Not bright, small	Highly favorable conditions
" 10	326	50	55	None	Not bright, small	Cooler than on July 8
" 15	715	88	67	None	Not bright, small	Highly favorable conditions
" 17	85	36	56	None	Not bright, small	Cooler than on July 15
" 22	111	39	55	None	Fairly bright	Moonlight somewhat unfavorable
" 24	102	35	58	Light	Bright, nearly full	Moonlight unfavorable
" 29	84	26	61	None	Bright	Brilliant moonlight
" 31	366	74	63	Heavy	Mostly overcast	Highly favorable conditions
Aug. 5	62	18	50	None	Bright	Cool with bright moon
" 7	182	52	57	None	Bright	Higher temperature than on Aug. 5
" 13	292	47	57	None	Fairly bright	Generally favorable for flight
" 15	174	39	48	None, fog in morning	Fairly bright in evening	Cool temperature for flight
" 19	241	45	65	Fog most of night	Bright in evening	Generally favorable
" 21	65	21	55	A few, light	Bright most of night	Cool and moon too bright
" 26	124	24	53	None	Full moon	Moonlight unfavorable
" 29	64	17	45	Medium heavy	Mostly overcast	Very cool most of night
Sept. 3	399	60	59	Heavy	Completely overcast	Highly favorable conditions
" 11	539	51	59	Heavy	Completely overcast	Apparently all conditions favorable
" 17	130	25	58	Scattered, light	Partly overcast	Moonlight unfavorable
" 19	55	15	51	None	Bright in evening	Moonlight unfavorable
" 23	333	38	63	Heavy	Completely overcast	Highly favorable conditions
" 24	58	19	59	None	Bright most of night	Moonlight unfavorable

The effects of temperature and of other meteorological conditions upon the flight of moths to light have been recognized and reported upon by a number of investigators. Comprehensive studies, however, are not numerous. Ainslie (1917, p. 114) reports that there is no correlation between the size of the catch of Crambid moths and temperature or humidity. Bensel (1918, p. 303) and Criddle (1918, p. 73) found that favorable nights for securing moths were warm, cloudy, humid, and with no wind. Crumb (1929, p. 173) suggests that one or more broods of moths of the species may have reproduced before meteorological factors were favorable for the taking of moths in considerable numbers at light traps.

A number of tables are presented in this paper in connection with the different types of light used during the project. Data are briefly given setting forth the conditions of temperature, clouds, and moon. Temperature and wind records were made early in the evening each night the lights were operated and again about midnight. No attempt at a general analysis of the data is made. The selected tables, given below, indicate, however, that warm, cloudy nights, often accompanied by rain and with little or no wind were most favorable for capturing moths. The tables also show that a wide range in numbers of moths may be obtained on consecutive nights if weather conditions change rapidly.

INFLUENCE OF THE KINDS OF LIGHT USED UPON THE NUMBER OF MOTHS CAPTURED

During the last three years of this study, four types of lamps, each with a different light intensity and one which produced a certain amount of ultraviolet light, were observed with respect to their influence upon the number of moths captured. For a total of 61 nights in 1932, 1933, and 1934, the mercury-vapor lamp was operated. The lamp used transmits 7,200 lumens of light and 800 E-vitons. It is in the E-vitons that the ultraviolet rays are found. The light source originated from an S 1 bulb, "Sunlamp," purchased from the General Electric Company. By means of a special attachment an electric cord was arranged to extend from the transformer to the Sunlamp at the correct height above the kerosene pan.

The lamp of greatest intensity was a 1,000 "Mogul" bulb which produced 20,700 lumens of light and no ultraviolet. This lamp was

used in making tests for a total of 51 times during 1933 and 1934.

A 500 watt frosted lamp was operated for 31 nights in 1932 and 1933. This 500 watt lamp, while producing light of less intensity than the 1,000 watt "Mogul," exceeded the S 1 lamp, "Sunlamp," in its luminosity, since the 500 watt lamp developed 9,800 lumens of light and the "Sunlamp" 7,200.

The fourth lamp on test was 200 watt clear Mazda. This lamp produced 3,900 lumens of light and accordingly it was lowest of all in light intensity. The 200 watt light was used in tests on 45 different dates in 1932 and 1933.

The lamps in every case were set up on the same site and tested under uniform conditions as to the kerosene pan. As only one lamp per night was operated, the bulbs of the different lights were frequently used on alternate dates. Although the 200 and 500 watt lamps were operated somewhat less frequently in the tests than the other two lamps, sufficient data were gathered to make suggestive comparisons. These data are compiled mostly from tests made during that part of the season in which the moths were abundant, namely, from approximately June 15 to September 20.

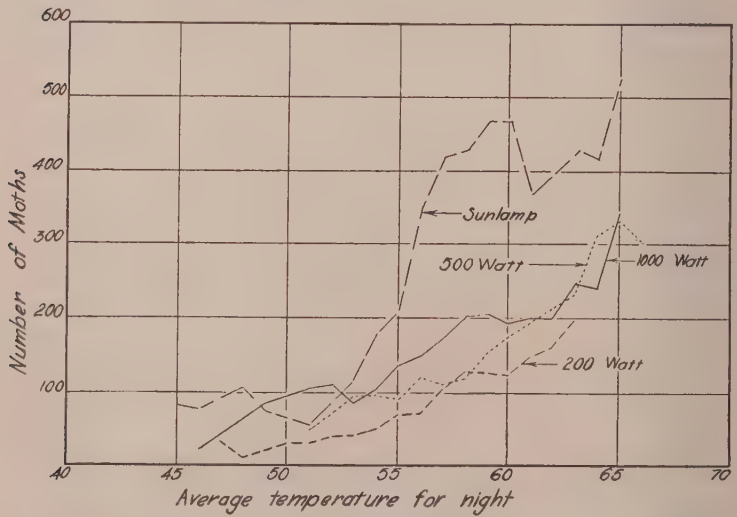

FIG. 30. Graph showing the relation between number of moths captured and type of light used. At temperatures below 53° F. all lights were approximately equally efficient. Above 53° F. the "Sunlamp" was the most effective source of light for attracting moths.

The results with the four lights are set forth in Figure 30. The graph is based upon the mean for the number of moths captured at each degree of temperature. At low temperatures between 45° and 53° Fahrenheit all the light sources tested were approximately equal in value for capturing moths. At temperatures above 53 degrees Fahrenheit, the S 1, mercury vapor lamp, "Sunlamp," was superior to that of any other lamp with which it was compared. At all temperatures, the 1,000, the 500, and the 200 watt lamps were nearly equal in their capacity for attracting moths. The number of moths captured by all the lamps tested was substantially larger at the higher temperatures.

The larger number of specimens obtained with the Sunlamp in comparison with the 1,000 and 500 watt lamps is of interest. Since the Sunlamp alone transmitted light in which ultraviolet rays were present and since the light intensity from the Sunlamp was lower than either the 1,000 or 500 watt lamps, it is evident that the increased attractiveness must have been due to the light-rays peculiar to the mercury vapor bulb or Sunlamp.

Of recent years, a number of investigators have shown rather conclusively that insects in general are especially responsive to the shorter wave-lengths of the visible spectrum and to ultraviolet rays. Lutz and Richtmyer (1922, p. 519) found as far back as 10 years ago that the fruit-fly, Drosophila, showed a strong positive response to ultraviolet rays. Two years later, Lutz (1924, p. 181) and coworkers while studying the color reaction of insects which visit flowers were able to demonstrate that certain insects perceive ultraviolet better than they do colors that appear bright to the human eye. The work of Peterson and Heussler (1928, p. 353) with the codling moth (*Carpocapsa pomonella*) and the Oriental fruit moth (*Laspeyresia molesta*) were of a fundamental nature in establishing the photic responses of these two insects. In their experiments, they showed definitely that both insects exhibit a high response to rays of the shorter wave-lengths and that ultraviolet is highly attractive. Within later years, Collins and Machado (1935, p. 103) have published results of studies upon the physiology of the compound eyes of the codling moth. Their work indicates clearly that the codling moth is most sensitive to light rays near the ultraviolet, violet, and blue regions, and that pigment migration in the compound eyes is intensified by these same light rays. Imms (1931, p. 142) in

reviewing the reactions of insects to lights and the practical application of such knowledge states, "There seems, also, little doubt that more can be done toward improving the efficiency of the light source itself. More attention needs to be given to light rich in violet and ultraviolet rays."

While the results of these investigators do not have a direct bearing upon the Macrolepidoptera, in which the writer is interested, their results are highly suggestive with respect to the large numbers of moths collected at the Sunlamp trap at Orono.

SUMMARY

Life history data concerning numerous species of Macrolepidoptera have been obtained by means of light-traps operated throughout a four-year period extending from 1931 to 1934.

The light traps were used three or four nights weekly from May to October during each year.

During the first year, the moths were captured in a light-trap constructed in the form of a truncate tin cone which was arranged above a rectangular wooden box. Throughout the course of the other three seasons, the specimens were taken in a 21-inch kerosene pan over which the lights were suspended.

A total of 56,131 individual specimens representing 349 species were captured and examined during the four-year period.

Data pertaining to the sex and time of flight of moths captured are presented. All females were dissected to determine the presence and degree of development of the eggs.

The number of generations per season and the time of adult activity have been definitely established for over 100 species of Lepidoptera at Orono, Maine.

The known range of distribution of a number of species has been extended. Among the unusual captures, were found 30 or more species which were taken for the first or second time in Maine. Small numbers of rare species, also, were taken at frequent intervals.

Of the total number of moths captured during the study, 22.5 per cent were females and 77.5 per cent were males. The percentage consisting of females varied as much as 10 per cent for different seasons. Among a few species of the moths the females occurred in greater numbers than the males.

Eighty-two per cent of all the females were gravid. This is a somewhat higher percentage of gravid females than has been reported by other investigators who have studied the Macrolepidoptera at lights.

A fairly close relationship was observed between temperature and the number of moths captured. Few or no moths were taken during nights with an average temperature of 40 to 42 degrees Fahrenheit. In contrast, large numbers of moths, frequently consisting of hundreds of specimens, were obtained during nights with temperatures of 58 degrees Fahrenheit or above, provided other conditions were favorable.

Warm, cloudy nights often accompanied by rain and with little or no wind were most favorable for capturing moths.

A mercury vapor "Sunlamp" that transmits a portion of its light rays in the violet and ultraviolet range were found to be superior to two other lamps of greater luminosity, which developed no ultraviolet.

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